Energy Monitoring And Control System Feasibility Study

Executive Summary
Volume 1 of 5

for

Fort Riley, Kansas

Contract No. DACA 45-78-C-0106

Prepared for

U.S. Army Engineer District, Omaha
Corps of Engineers
Omaha, Nebraska

1982

78-808-4

Burns & McDonnell
ENGINEERS - ARCHITECTS - CONSULTANTS

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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November 12, 1982

U. S. Army Engineer District, Omaha
Corps of Engineers
6014 U. S. Post Office and Courthouse
Omaha NE 68102

Fort Riley Kansas
Energy Monitoring and Control System
Contract No. DACA 45-78-C-0106

Gentlemen:

We present herewith our feasibility report for the Energy Management and Control System for Fort Riley, in accordance with our agreement dated April 9, 1981.

The report reviews the expected costs and energy savings attributable to the proposed EMCS.

Respectfully submitted,

Kenneth M. Clark, P.E.

Warren A. Roberts, P.E.

Stephen A. Robusto, P.E.

KMC/WAR/SAR/nlc

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VOLUME 4 - BUILDING SUMMARY FORMS

Contains field survey notes for Buildings 3 thru 7520. Pages are not numbered, but are indexed by building number.

VOLUME 5 - BUILDING SUMMARY FORMS

Contains field survey notes for Buildings 7602 thru 8360. Pages are not numbered but are indexed by building number.

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

The proposed EMCS exceeds all minimum requirements for energy-related military construction. Table SC-1 lists the important facts related to the project.

TABLE SC-1
EMCS PROJECT - IMPORTANT FACTS

Project Cost	$4,566,470 (Feb 82)
Project B/C ratio	2.1
Project E/C ratio	41
Payback Period	6.2 years
Number of Points	2318 (large)
Number of Buildings Controlled	179

Table SC-2 (page S-7) is a cost breakdown for the EMCS project and Table SC-3 (page S-8) summarizes the economic analysis.

EXPECTED BENEFITS OF EMCS

Experience has shown that an EMCS system can:

1. Increase work force productivity. Automated surveillance of utility plants will permit reductions in staffing levels for the plants.
2. Reduce operating costs, by increasing work force productivity and by improving control over utility expenditures.

3. Improve service to users. The EMCS will provide the ability to identify and fix problems often before a building occupant realizes that a problem exists.
4. Allow systematized maintenance of utilities. The EMCS will show computerized scheduling and record keeping of preventive maintenance and cyclic maintenance tests.
5. Improve record keeping. Large amounts of operating data will be readily available to the facilities engineer. Good records will simplify budgeting and planning.
6. Allow automatic reading of utilities meters.
7. Reduce basewide energy consumption and electrical demand.
8. Reduce tampering and vandalism of manual controls.
9. Avoid damage due to power outages and freeze-ups.
10. Assist in fire detection and monitoring of intrusion alarms.

Future Buildings

Future developments are not included in this study but the impact of planned projects must be recognized.

Over 70 new buildings and additions are proposed for FY84 and 85. These projects will increase the EMCS responsibility by at least 500 points.

Maintenance Points

This project includes maintenance points as well as energy points. An understanding of the two classes of points is important; see Appendix B for a full explanation.

The cost attributable to energy points is about $2.8 million. A life-cycle analysis of the energy points resulted in an E/C ratio of 41 and a payback of 2.9 years.

We are not recommending a project consisting of energy points alone, because energy points cannot reduce the ever-increasing burden on maintenance forces at Ft. Riley. This burden is a prime concern, and the maintenance points make the EMCS a very effective support tool.

Choice of EMCS

The Corps of Engineers has the option to save nearly $260,000 by deviating from the Tri-Services Specification (Reference 11), and sacrificing some capabilities and reliability.

Master Control Room

The Master Control Room will be located in the basement of the Facilities Engineer's Building, No. 187. Architectural, electrical and

mechanical modifications for the Master Control Room will cost approximately $28,100.

Remote Monitoring Station

A remote monitoring station will be located in Hospital Boiler Plant 486. It will reduce staffing requirements. The remote station will cost approximately $19,300.

Data Transmission

All data transmission will be via voice-grade telephone lines. Sixteen pairs of phone lines will be leased from United Telephone. A large number of new government-owned phone lines will be needed. The availability of spare phone lines may change; subsequent improvements may reduce the need for additional lines provided as part of this project.

Demand Limiting

We have estimated demand limiting will save $100,000 (February 82 dollars) each year. The actual savings will depend on Ft. Riley's commitment to keep an adequate number of low priority consumers.

Existing Controls

In general, the existing control systems were in satisfactory condition. We recommend a sum of $50,000 for rehabilitation of old controls which either don't work properly or are incompatible with the EMCS.

The EMCS will enhance the old controls. We foresee no instances where the effectiveness of existing controls will be sacrificed to accommodate the EMCS.

Staffing

Only one new man (WG11) will be needed to staff the Ft. Riley EMCS. All other positions can be filled by reassignment of existing personnel.

Other Future Capabilities

The cost to monitor sewage lift stations would be $9,000. This is not included in this study.

Demand limiting for family housing is not recommended now, but may be practical in the future. Such demand limiting would probably be accomplished via FM radio, and interfaced with the EMCS.

Motor burnouts could be prevented by monitoring the three phases of electricity at vulnerable locations.

* * * * *

Table SC-2
COST SUMMARY FOR EMCS PROJECT
(February 1982 dollars)

1a.	Central Computer Equipment[1]	$494,300	
b.	FID's[2]	181,500	
c.	MCR[3]	28,100	
d.	Remote Monitor[4]	19,300	
	Subtotal 1	$723,200	$723,200
2a.	Field Hardware[5]	$2,729,740	
b.	Modifications to existing controls[5]	20,600	
c.	DTM[6]	259,890	
	Subtotal 2	$3,010,230	$3,010,230
3a.	Training[7]	14,600	
b.	Documentation[8]	172,650	
	Subtotal 3	$187,250	$187,250
4.	Allowance for control work		$50,000
5.	Contingencies[9]		$378,340
6	Supervision and Administration[10]		$217,450
		Total Project Cost	$4,566,470

Notes:

ITEMS 1,2,3,4 INCLUDE CONTRACTOR'S OVERHEAD AND PROFIT

[1] *See Table I-1 (page I-2).*

[2] *11 FID's x $16,500 each.*

[3] *See Table II-7 (page II-137).*

[4] *See Table II-8 (page II-138).*

[5] *See Table II-1 (page II-3 through II-11).*

[6] *See Table II-1 (page II-3 through II-11) and pages II-33 & 34.*

[7] *Based on manufacturer's estimate.*

[8] *5% x [1 + 2a].*

[9] *10% x [1 + 2 + 4].*

[10] *5% x (1 + 2 + 3 + 4 + 5).*

Table SC-3

ECONOMIC ANALYSIS SUMMARY
(July 1986 Dollars)

Economic Life: 15 Years

Cost			
1.	Nonrecurring Initial Capital Costs		
	a. CWE	$5,880,200	
	b. Design (5% of 1a)	294,010	
	c. Salvage Value of Existing System	Negligible	
	d. Total		$6,174,210
Benefits			
2.	Recurring Benefit/Cost Differential Other than Energy		
	a. Annual Labor Decrease (+)/Increase (-)[2]	$-34,820	
	b. Annual Maintenance Decrease (+)/Increase (-)[3]	$-447,730	
	c. DTM Rental (+)/Increase (-)[4]	$-4,821	
	d. Total Costs	$-487,371	
	e. 10% Discount Factor	7.980	
	f. Discounted Recurring Cost (dxe) (Note 1)		$-3,889,221
3.	Recurring Energy Benefit/Costs		
	a. Electricity		
	(1) Annual Energy Decrease	53,861/Mega Btu	
	(2) Cost per Mega Btu	$8.17/Mega Btu	
	(3) Annual Dollar Decrease	$440,044/yr	
	(4) Differential Escalation Rate (7%) Factor	10.57	
	(5) Discounted Dollar Decrease	$4,651,269	
	b. Natural Gas		
	(1) Annual Energy Decrease	68,958/Mega Btu	
	(2) Cost per Mega Btu	$6.68/Mega Btu	
	(3) Annual Dollar Decrease	$460,639/yr	
	(4) Differential Escalation Rate (8%) Factor	13.55	
	(5) Discounted Dollar Decrease	$6,241,664	
	c. No. 2 Fuel Oil		
	(1) Annual Energy Decrease	24,717/Mega Btu	
	(2) Cost per Mega Btu	$14.91/Mega Btu	
	(3) Annual Dollar Decrease	$368,530/yr	
	(4) Differential Escalation Rate (8%) Factor	11.41	
	(5) Discounted Dollar Decrease	$4,204,933	
	d. Electrical Demand Reduction		
	(1) Reduction in summer peak	3,750kW	
	(2) Annual Dollar Decrease	$162,676/yr	
	(3) Differential Escalation Rate (7%) Factor	10.57	
	(4) Discounted Dollar Decrease	$1,719,485	
	e. Discounted Energy Benefits [3a(5)+3b(5)+3c(5)+3d(4)]		$16,817,351
4.	Total Benefits (sum 2f+3e)		$12,928,130
5.	Discounted Benefit/Cost Ratio (Line 4 ÷ Line 1d)		2.1
6.	Total Annual Energy Savings [3a(1)+3b(1)+3c(1)]		147,536 Mega Btu
7.	E/C Ratio		41*
8.	Annual $ Savings [2d+3a(3)+3b(3)+3c(3)+3d(2)]		$944,518
9.	Pay-back Period [(Line 1a-Salvage) ÷ Line 8]		6.2 yrs

Table SC-3
ECONOMIC ANALYSIS SUMMARY
(July 1986 Dollars)
(Continued)

* *E/C ratio does not include maintenance points. See Appendix B.*

Notes:

[1] $Escalation = \frac{July\ 86}{Feb\ 82} = \frac{1580}{1227} = 1.288$

$4,566,470 \times 1.288 = \$5,880,200$

[2] *$27,040 x escalation = $34,820.*

[3] *$150/pt x 2318 pts x escalation = $447,730*

[4] *$19.50/mo-pr x 16 pr x 12 mo/yr x escalation = $4821/yr.*

INTRODUCTION

INTRODUCTION

A. PURPOSE

One objective of this study is to determine whether the proposed EMCS meets the minimum requirements for military construction related to energy conservation. These minimum requirements are expressed in References 2 and 3. The EMCS is to be justified on the basis of dollar savings over its 15-year life.

Another objective of this study is to establish the magnitude of the project, in terms of project cost, energy saved, and number of buildings effected.

B. SCOPE OF THIS FEASIBILITY STUDY

The approach to this study is described in Appendix E of this report. Briefly it involves these steps:

1. BUILDING LIST

Prepare a list of candidate buildings.

2. FIELD SURVEY

Conduct a field survey of all candidate buildings. Check such points as occupancy schedules, equipment types and condition.

3. PRELIMINARY ANALYSIS

Review each candidate building and evaluate energy conservation programs. Quantify expected energy savings and associated costs. Delete candidate buildings which do not prove to be viable targets for EMCS control.

4. FINAL ANALYSIS

Review and check all parts of the Preliminary Analysis. Amend as required. Prepare building summary tables for each building recommended for EMCS control. Prepare I/O Summary Table which lists all points on the proposed EMCS on a per-building basis. Prepare estimates of savings and costs. Perform economic analysis on overall system.

5. REPORT THE RESULTS

Prepare report, backup notes, and submittal forms for military appropriations.

C. COMPUTER PROGRAM

Burns & McDonnell uses the computer program DOE 1.4 (formerly called CAL-ERDA) to simulate Ft. Riley buildings. This program was developed jointly by the State of California and the United States Energy Research and Development Administration.

The program is divided into three major sections: LOADS, SYSTEMS and PLANTS.

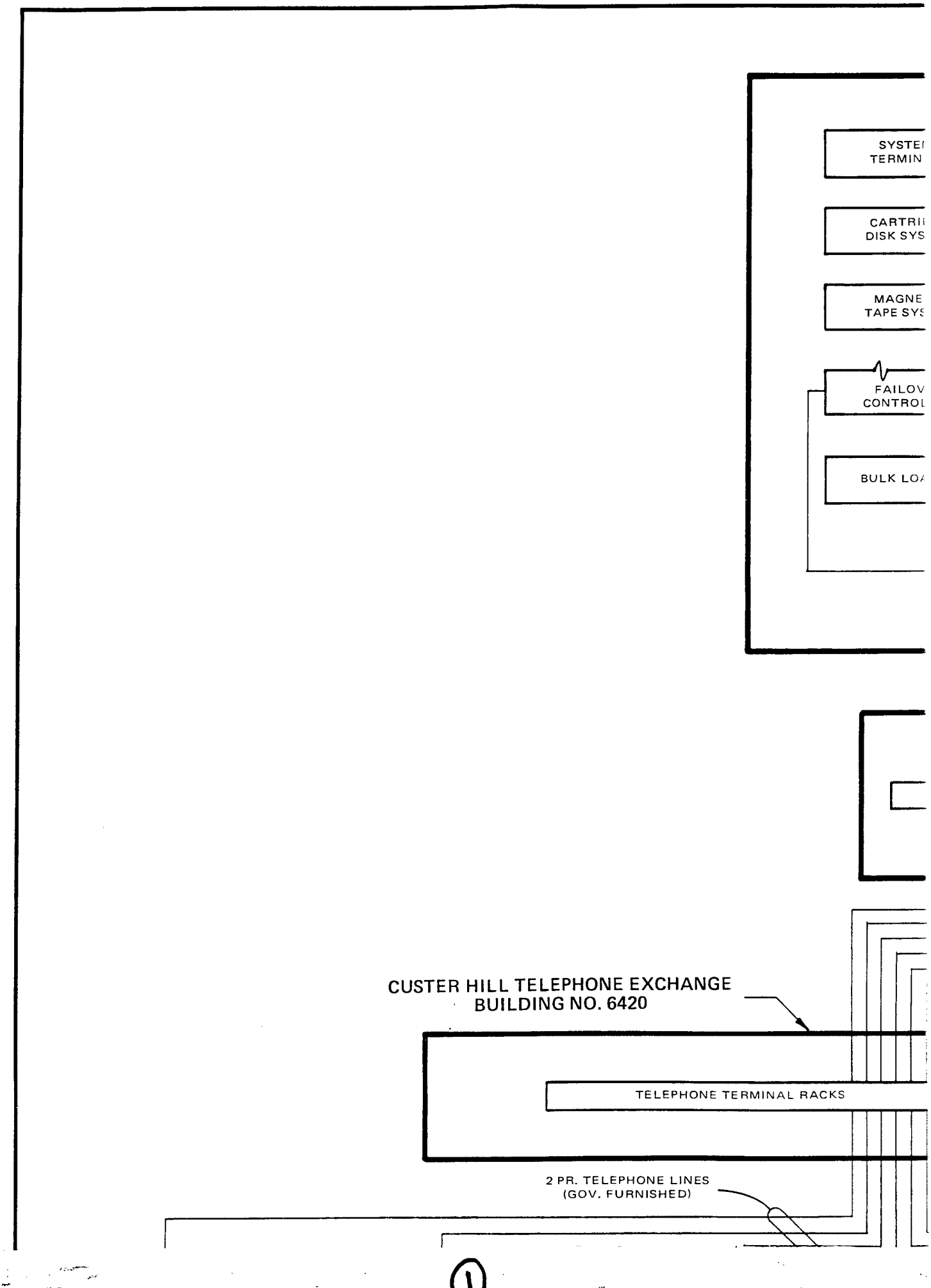
The LOADS portion takes the physical makeup of the building and weather tape data (a 1968 Ft. Riley weather tape was used for this study). LOADS calculates the hourly heating and cooling load for each zone.

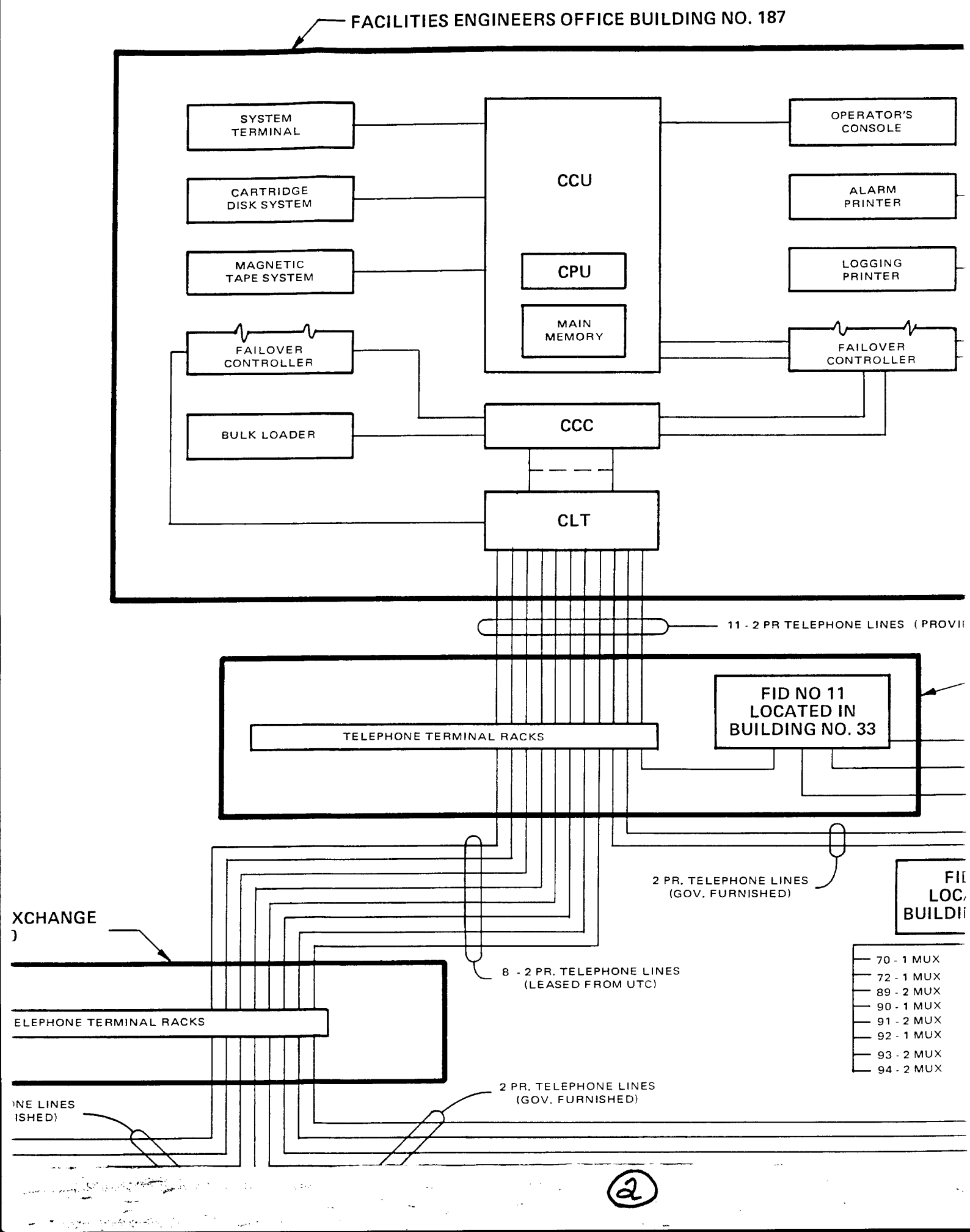
The SYSTEMS portion uses the LOADS output and integrates it with an HVAC system. The energy required for heating and cooling with the HVAC system is calculated. In this manner, SYSTEMS accounts for fans, HVAC controls, duct networks, unit heaters and the like.

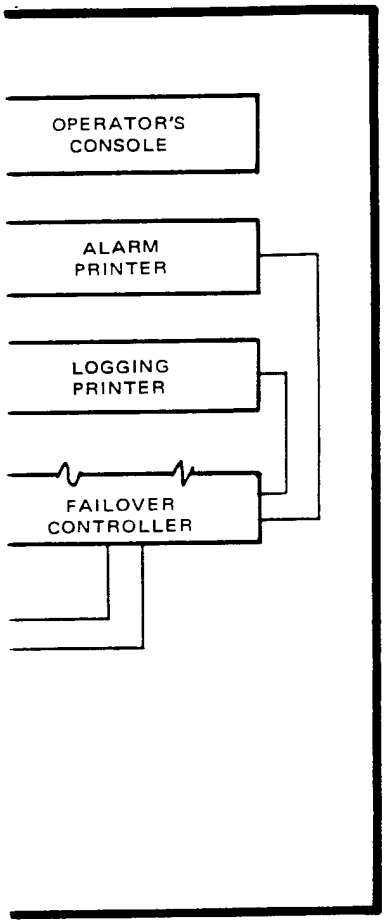
The PLANTS portion uses the SYSTEMS output and incorporates it with energy plant equipment. PLANTS simulates chillers, boilers and pumps by accounting for equipment inefficiencies.

The end product of DOE 1.4 is an energy use estimate derived from the hour-by-hour performance of the total building.

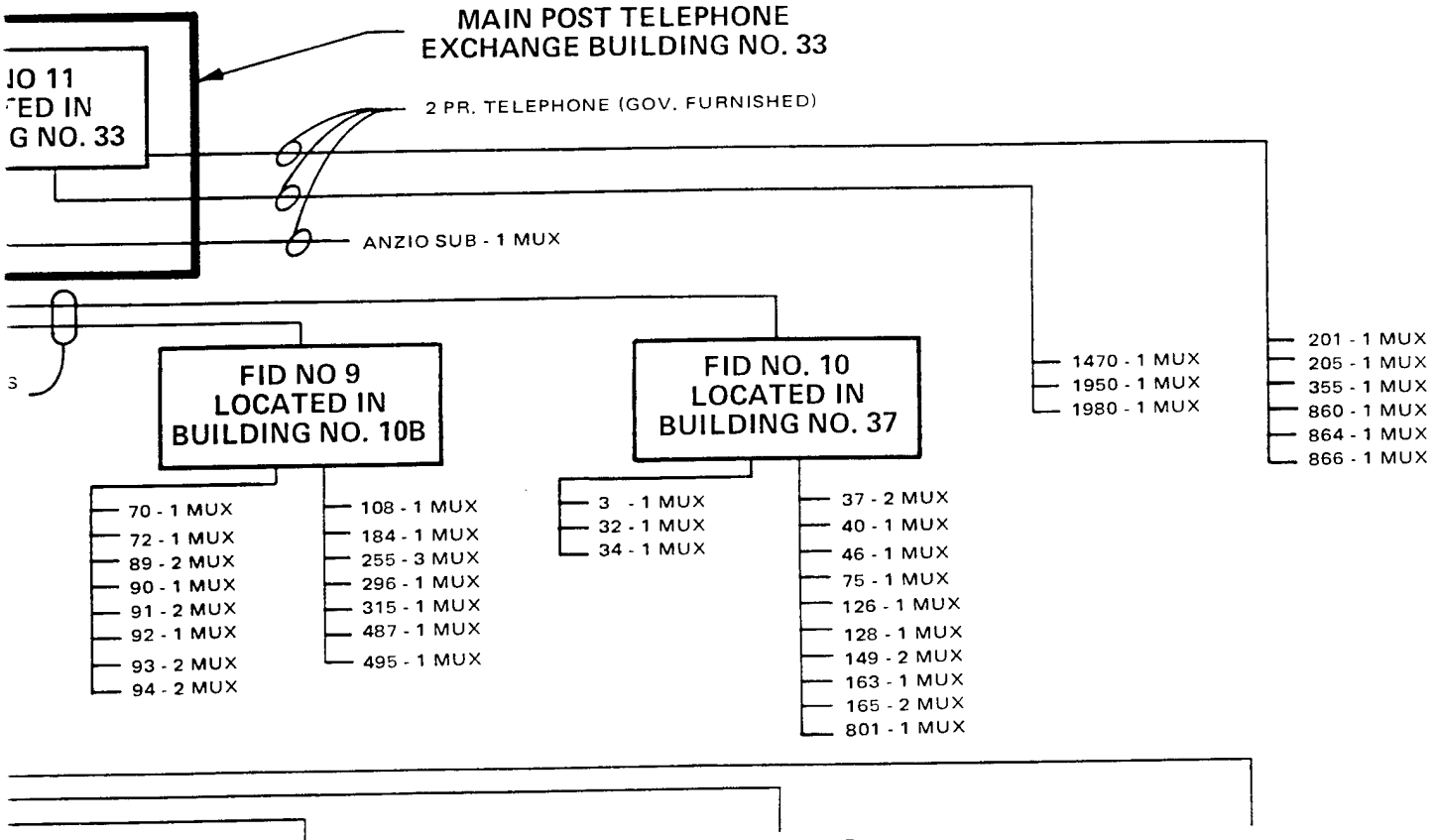
* * * * *

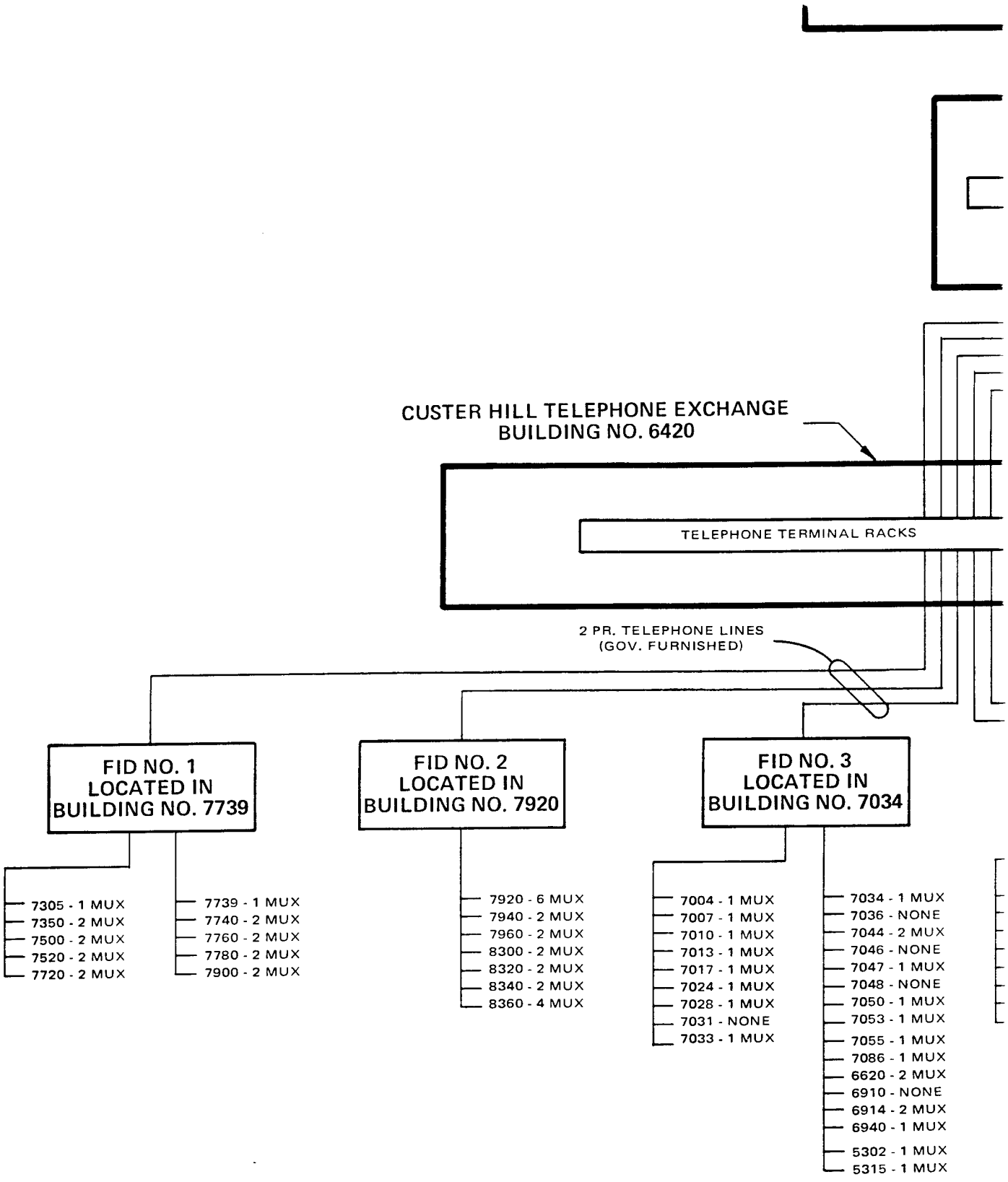

SYSTE
TERMIN
CARTRI
DISK SYS
MAGNE
TAPE SYS
FAILOV
CONTROL
BULK LO
CUSTER HILL TELEPHONE EXCHANGE
BUILDING NO. 6420
TELEPHONE TERMINAL RACKS
2 PR. TELEPHONE LINES
(GOV. FURNISHED)

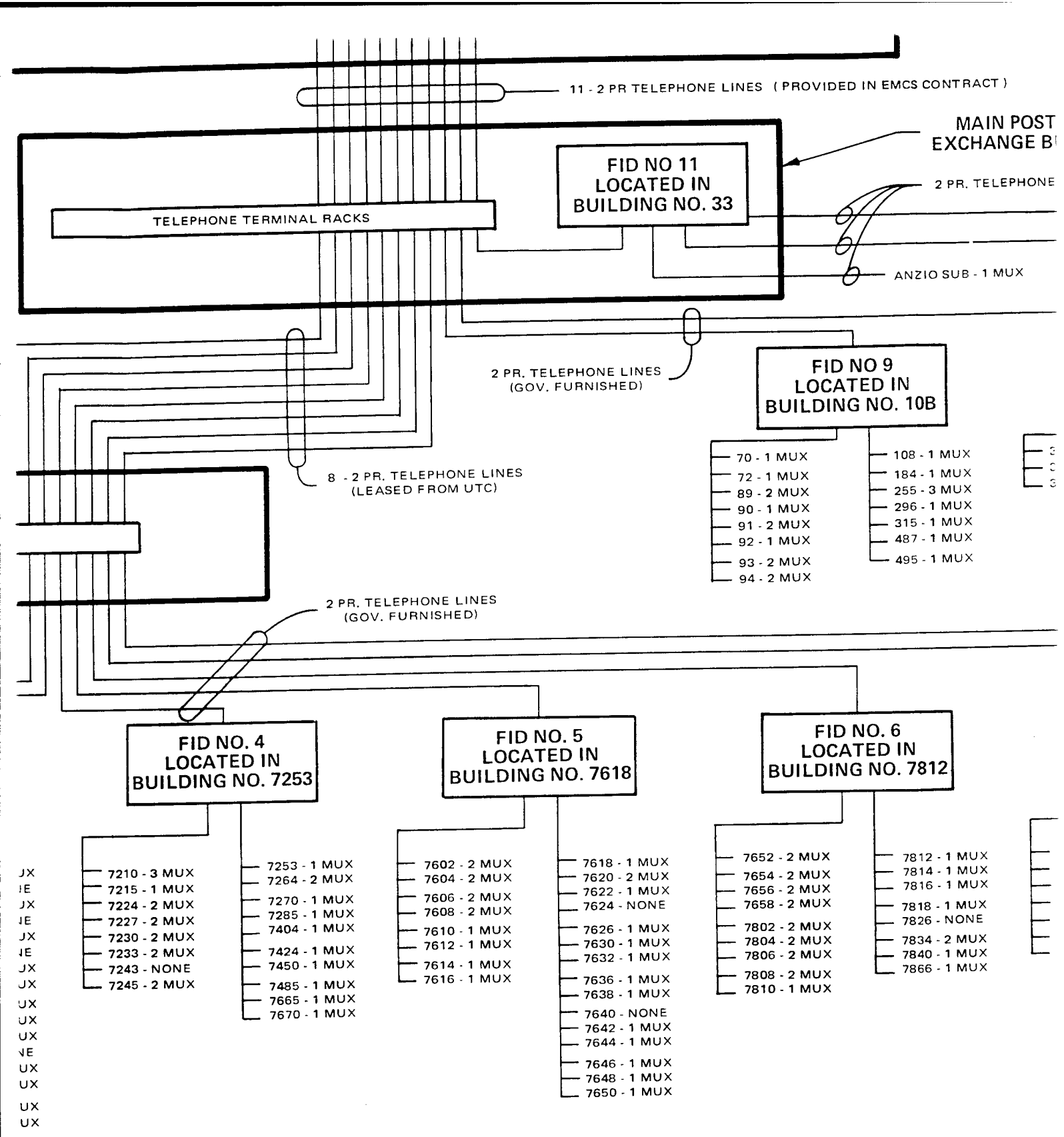

FACILITIES ENGINEERS OFFICE BUILDING NO. 187
SYSTEM TERMINAL
CARTRIDGE DISK SYSTEM
MAGNETIC TAPE SYSTEM
FAILOVER CONTROLLER
BULK LOADER
CCU
CPU
MAIN MEMORY
CCC
CLT
OPERATOR'S CONSOLE
ALARM PRINTER
LOGGING PRINTER
FAILOVER CONTROLLER
11 - 2 PR TELEPHONE LINES (PROVI
TELEPHONE TERMINAL RACKS
FID NO 11 LOCATED IN BUILDING NO. 33
2 PR. TELEPHONE LINES (GOV. FURNISHED)
XCHANGE
8 - 2 PR. TELEPHONE LINES (LEASED FROM UTC)
ELEPHONE TERMINAL RACKS
70 - 1 MUX
72 - 1 MUX
89 - 2 MUX
90 - 1 MUX
91 - 2 MUX
92 - 1 MUX
93 - 2 MUX
94 - 2 MUX
2 PR. TELEPHONE LINES (GOV. FURNISHED)
(2)



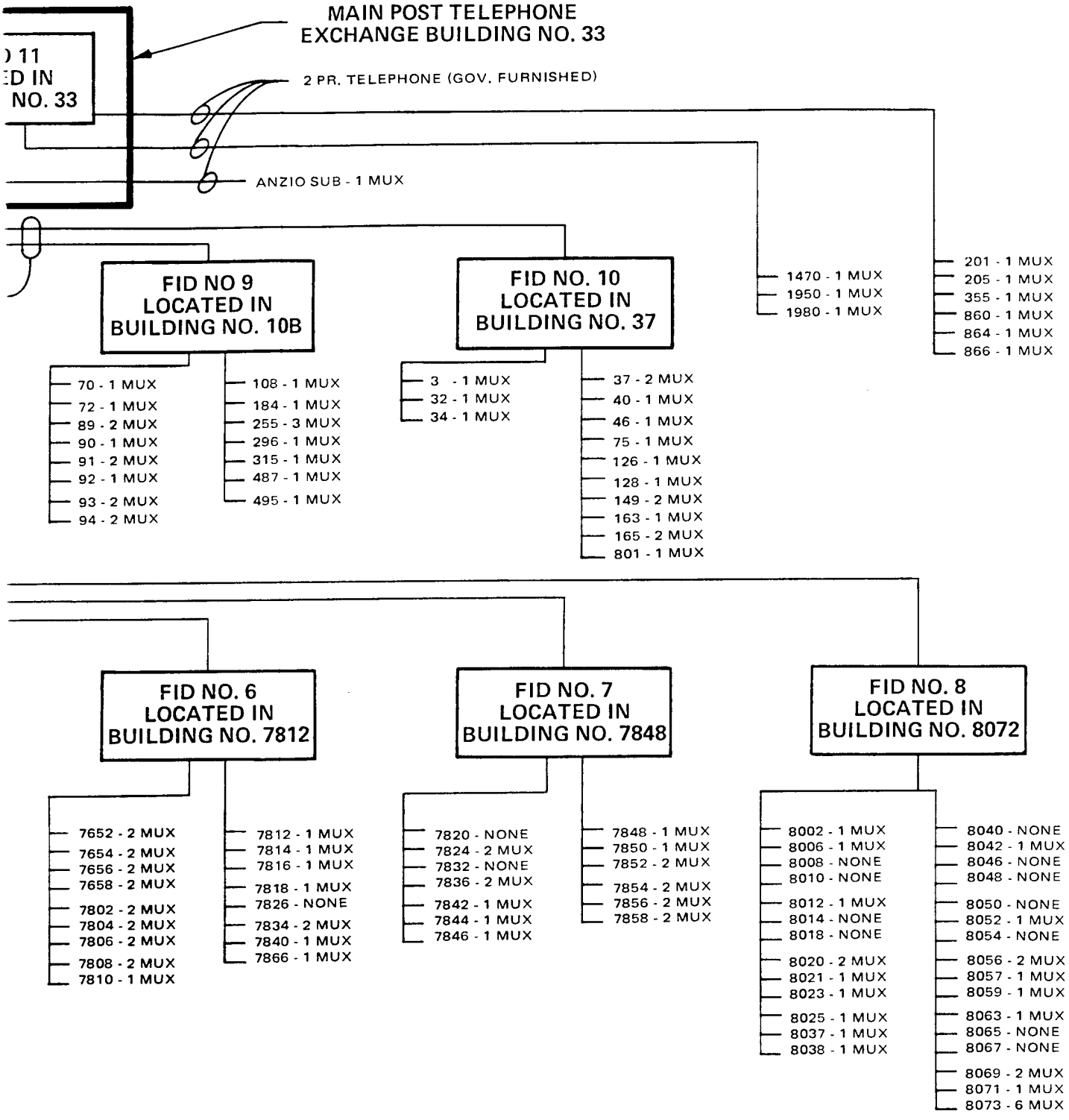
LEPHONE LINES (PROVIDED IN EMCS CONTRACT)




CUSTER HILL TELEPHONE EXCHANGE
BUILDING NO. 6420
TELEPHONE TERMINAL RACKS
2 PR. TELEPHONE LINES
(GOV. FURNISHED)
FID NO. 1
LOCATED IN
BUILDING NO. 7739
7305 - 1 MUX
7350 - 2 MUX
7500 - 2 MUX
7520 - 2 MUX
7720 - 2 MUX
7739 - 1 MUX
7740 - 2 MUX
7760 - 2 MUX
7780 - 2 MUX
7900 - 2 MUX
FID NO. 2
LOCATED IN
BUILDING NO. 7920
7920 - 6 MUX
7940 - 2 MUX
7960 - 2 MUX
8300 - 2 MUX
8320 - 2 MUX
8340 - 2 MUX
8360 - 4 MUX
FID NO. 3
LOCATED IN
BUILDING NO. 7034
7004 - 1 MUX
7007 - 1 MUX
7010 - 1 MUX
7013 - 1 MUX
7017 - 1 MUX
7024 - 1 MUX
7028 - 1 MUX
7031 - NONE
7033 - 1 MUX
7034 - 1 MUX
7036 - NONE
7044 - 2 MUX
7046 - NONE
7047 - 1 MUX
7048 - NONE
7050 - 1 MUX
7053 - 1 MUX
7055 - 1 MUX
7086 - 1 MUX
6620 - 2 MUX
6910 - NONE
6914 - 2 MUX
6940 - 1 MUX
5302 - 1 MUX
5315 - 1 MUX


11 - 2 PR TELEPHONE LINES (PROVIDED IN EMCS CONTRACT)
MAIN POST EXCHANGE B
FID NO 11 LOCATED IN BUILDING NO. 33
2 PR. TELEPHONE
TELEPHONE TERMINAL RACKS
ANZIO SUB - 1 MUX
2 PR. TELEPHONE LINES (GOV. FURNISHED)
FID NO 9 LOCATED IN BUILDING NO. 10B
70 - 1 MUX
72 - 1 MUX
89 - 2 MUX
90 - 1 MUX
91 - 2 MUX
92 - 1 MUX
93 - 2 MUX
94 - 2 MUX
108 - 1 MUX
184 - 1 MUX
255 - 3 MUX
296 - 1 MUX
315 - 1 MUX
487 - 1 MUX
495 - 1 MUX
8 - 2 PR. TELEPHONE LINES (LEASED FROM UTC)
2 PR. TELEPHONE LINES (GOV. FURNISHED)
FID NO. 4 LOCATED IN BUILDING NO. 7253
7210 - 3 MUX
7215 - 1 MUX
7224 - 2 MUX
7227 - 2 MUX
7230 - 2 MUX
7233 - 2 MUX
7243 - NONE
7245 - 2 MUX
7253 - 1 MUX
7264 - 2 MUX
7270 - 1 MUX
7285 - 1 MUX
7404 - 1 MUX
7424 - 1 MUX
7450 - 1 MUX
7485 - 1 MUX
7665 - 1 MUX
7670 - 1 MUX
FID NO. 5 LOCATED IN BUILDING NO. 7618
7602 - 2 MUX
7604 - 2 MUX
7606 - 2 MUX
7608 - 2 MUX
7610 - 1 MUX
7612 - 1 MUX
7614 - 1 MUX
7616 - 1 MUX
7618 - 1 MUX
7620 - 2 MUX
7622 - 1 MUX
7624 - NONE
7626 - 1 MUX
7630 - 1 MUX
7632 - 1 MUX
7636 - 1 MUX
7638 - 1 MUX
7640 - NONE
7642 - 1 MUX
7644 - 1 MUX
7646 - 1 MUX
7648 - 1 MUX
7650 - 1 MUX
FID NO. 6 LOCATED IN BUILDING NO. 7812
7652 - 2 MUX
7654 - 2 MUX
7656 - 2 MUX
7658 - 2 MUX
7802 - 2 MUX
7804 - 2 MUX
7806 - 2 MUX
7808 - 2 MUX
7810 - 1 MUX
7812 - 1 MUX
7814 - 1 MUX
7816 - 1 MUX
7818 - 1 MUX
7826 - NONE
7834 - 2 MUX
7840 - 1 MUX
7866 - 1 MUX

PHONE LINES (PROVIDED IN EMCS CONTRACT)



Burns & McDonnell
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Figure 1

ENERGY MONITORING AND CONTROL SYSTEM BLOCK DIAGRAM

OCTOBER, 1982

PART I – DESCRIPTION OF EMCS

PART I

DESCRIPTION OF EMCS

A. FT. RILEY EMCS

The building analysis (described in Part II of this report) resulted in a large-sized EMCS. Figure I-1 (page I-29) is a block diagram of the proposed system.

The MCR will be located in Building 187.

There are eleven FID panels, each centrally located in its own zone of responsibility. This layout is based on FIDs which can accommodate approximately 60 MUX connections; different manufacturers may require an alternative arrangement. Ample allowance has been made for adding more buildings later.

Some buildings will have more than one MUX; some buildings will have no MUXs of their own, but will be served by MUX panels in nearby buildings. The actual number will depend again on the manufacturer.

Availability of phone lines changes from day to day, but at present, we anticipate only 16 pairs of phone lines will be leased from

United Telephone. All other phone lines will be either government-furnished, or installed new.

Table I-1 lists projected costs for the components of the central computer.

TABLE I-1
COSTS FOR CENTRAL COMPUTER EQUIPMENT
FOR TRI-SERVICES LARGE EMCS
(February 1982 dollars)

Item	Cost
CPU	$ 70,900
CCC	25,000
Color CRT	10,100
B&W CRT	9,600
Alarm Printer	4,700
Disk Drive	32,200
Magnetic Tape	32,600
Floppy Disk	8,600
Calendar Clock	3,800
Software	121,000
Communication Link Controller	9,800
Test Equipment	32,000
Contractors OH&P	134,000
Total	$494,300 (Feb 82)

Table I-2 lists costs for field hardware.

TABLE I-2
ESTIMATED UNIT PRICES FOR FIELD HARDWARE
(February 1982 dollars)

Item	Cost
FID	$16,500
MUX	1,890
Air temperature point	800
Water temperature point (Note 2)	850
Pressure or humidity point	1,350
Damper position indicator point	1,200
Alarm contact point	650
Binary temperature point	650
Start/stop point w/status	1,150
Start/stop point w/o status	1,000
Status only	650
Control point adjustment (CPA)	1,360
Accumulator (kW input)	2,450
Accumulator (demand meter contact)	780
Analog flow (Note 2)	2,700

Notes
1. Estimates above include labor, material, on-post travel time allowance, wiring allowance (100 feet per point).
2. Estimate includes allowance for installation of sensor well in piping.

B. MANAGEMENT SUPPORT

Management support is the key to success of an EMCS system. The facilities engineer staff must want the system and give emphasis to its use as a management tool. The Commander must also support the use of EMCS for management of utilities and for energy control, and particularly for demand limiting.

C. STAFFING[1]

Staffing of EMCS has been a problem area for the following reasons:

1. Commanders are restricted by fixed or dwindling manpower allocations while mission requirements continue to increase.

2. Utility divisions are currently staffed at only 70 percent of recognized strength

As a result, facilities engineering staffs, particularly the utilities division, currently function under crisis management conditions (in general). The facilities engineer has been forced to contract increasing portions of the work load in order to carry out mission responsibilities.

Experience has shown that automation of utility plants (such as boiler houses) is the best method to obtain staff spaces for the EMCS. Experience has also shown that it is better to staff the operation with in-house personnel rather than contract for such services. There is a need for close coordination between EMCS operators and other components within the facilities engineers

[1] This is based on References 23 and 24.

group, and outside contractors have been unsuccessful in achieving this.

The EMCS should be staffed during the construction phase so that the operators may see the controls and equipment as they are installed and observe the calibration of controls and instrumentation. Early staffing will also permit time for school and going to job training.

In-house controls technicians can be trained to take over the responsibilities of maintenance and calibration of almost all EMCS field equipment and instrumentation if proper training is provided.

The operator positions should be wage grade (WG) to minimize hiring difficulties.

It is expected that seven positions will be needed to man the EMCS. These positions will consist of:

Position	Strength	Grade Type
Chief, Energy Branch	1	GS
Chief, EMCS, Operations & Maintenance	1	GS
Energy Conservation Officer	1	GS
Utilities Sales Officer	1	GS
Utilities Systems Controllers	3	WG

The four GS positions described here can be assumed by existing personnel. Establishing this upper part of the organization should

be fairly easy, since the Facilities Engineer group at Ft. Riley already has a similar layout.

Two of the three controller positions will be filled by retrained HVAC mechanics. These two positions will be reassigned from round-the-clock duty at Building 8073.

Only one new position will need to be created to staff the EMCS. This new position is expected to be a WG level 11.

The three controller/mechanics will provide only 40-hour-per-week coverage of the EMCS. For other hours, boiler operators in Building 486 will monitor the system.

Boiler operators in Building 486 presently provide round-the-clock surveillance. As part of their routine duties, they care for the hospital EMCS.

D. IMPACT ON MAINTENANCE MANAGEMENT

Experience has shown that preventive maintenance and cyclic maintenance management capabilities can be added to the EMCS software for little additional cost. By using the real time clock of the computer, run times can be tracked for all equipment that has

the start/stop capability with EMCS. Using this feature, the computer can help set up a calendar day based maintenance schedule and can help provide records on maintenance activities.

As mentioned earlier, control technicians can be trained to take over the responsibility of maintaining and calibrating the EMCS field equipment and instruments. However, a maintenance contract with the EMCS manufacturer will probably be required to take care of central computer equipment.

E. CHOICE OF EMCS CAPABILITIES

Many factors affect the decision for an EMCS for Ft. Riley. The important features to be considered in the choice are programmability, FID capabilities, compatibility with the existing Hospital EMCS, and costs.

The Tri-Services Spec (Reference 11) calls for specific features in a large-sized EMCS. The Spec requires the EMCS to be reprogrammable by the operator. It also calls for stand-alone FIDs. Such requirements make the Tri-Service EMCS unlike those planned for the private sector. Such requirements may make the Tri-Service EMCS a special system, which only the military will own. Consequently, costs to purchase, operate and maintain may be higher.

The reprogramming feature may be of questionable value; the computer may never need reprogramming. At worst, changes in programming will be infrequent (as we see it). It will probably be cheaper to have the manufacturer modify the program than to train and keep operators who are capable of reprogramming.

The stand-alone FID is capable of taking over most EMCS functions in the event of a CPU failure. This requirement, too, may be unnecessary, since powerful MUX panels are being developed with nearly stand-alone capability.

In addition to these other considerations, it has been suggested that the proposed EMCS be linked to, and control, the existing JC80/35 which serves Irwin Army Hospital. A reduction in operating expenses would result from the link, but the Hospital EMCS cannot be tied easily to any Tri-Service Spec EMCS--the respective structures are too different.

The EMCS cost can vary substantially with differences in features. Table I-3 is presented for illustrative purposes only. It is based on features and costs available from one manufacturer.

TABLE I-3
COMPARISON OF THREE EMC SYSTEMS

Features	EMCS A	EMCS B	EMCS C
Meets Tri-Service Spec	Yes	No	No
Easily Linked to Hospital EMCS (Note 1)	No	Yes	No
Reprogrammable by Operator	Yes	No	No
Stand-alone FIDs	Yes	No	No
CPU Cost (See Notes 2,3)	$494,000	$307,000	$219,000
Cost Differences vs. EMCS-A (Note 3)	-	$187,000	$275,000

Notes:
EMCS-A conforms to the Tri-Services Spec for large systems. It includes a backup computer (the CCC). It has the full distributed processing hierarchy: computer over FIDs and MUXs.

EMCS-B is the same EMCS model as the one in use at Irwin Army Hospital. This EMCS has no backup computer. It has no FIDs, but has IMUXs instead of MUXs.

EMCS-C is similar to EMCS-B. EMCS-C can only handle 2,000 points.

1. Cost to link EMCS-A to Hospital EMCS is approximately $213,000. Cost to link EMCS-C to Hospital EMCS is $234,000.
2. Costs include computer equipment, plus training and SIOH.
3. Costs are expressed in February 1982 dollars.

F. STRUCTURE[2]

1. The modern EMCS consists of a central processing unit (CPU), memory, storage devices, input/output (I/O) devices, a data communications processor, data transmission media (DTM), field interface device (FID) panels, multiplexer (MUX) panels, instrumentation, and controls. The primary task of the CPU with its memory and storage devices is to automatically perform control and monitoring functions. The control functions require the execution of complex optimization algorithms used to predict environmental conditions and rate of power consumption, calculate equipment operating points, and produce control signals to operate equipment in the real-time environment. The central computer also provides the operator-machine interface required for the EMCS operation. The function of the FID is to collect data and issue control commands to the local equipment, the FIDs data environment (DE). FIDs have a microcomputer that performs local control, monitoring, and communications functions. Data from the FID is transferred via DTM to the central computer where it is utilized to perform control and

[2]The following section is borrowed largely from Reference 1.

monitoring functions, optimization calculations, and alarm reporting.

2. EMCS can be classified into four categories in accordance with the total number of points connected to the system, system function and operational requirements: (1) large EMCS in excess of 2000 points; (2) medium EMCS with 500 to 2500 points; (3) small EMCS with 50 to 600 points; and, (4) micro EMCS with less than 125 points.

   This study has concluded that a large EMCS is appropriate for Ft. Riley.

3. Special terminology is used for subsystem components. Major components of the large EMCS consist of the following:

   a. Central Control Unit (CCU)

      A minicomputer or microcomputer, with memory for the operating system software and implementation of energy conservation program. Arithmetic computations and logical decision functions necessary to perform control and monitoring are performed in the CCU. Data and programs are stored or retrieved from the memory or mass storage devices.

The CCU has programmed I/O ports for specific equipment, such as printers, cathrode ray tube (CRT) consoles, and magnetic tape systems. The CCU has direct memory access (DMA) controllers for high-speed data transfer between the CCU and mass storage devices, such as disk systems. The CCU is the highest priority device and may override or direct the operation of all other EMCS components, except safety interlocks.

b. Central Communication Controller (CCC)

A minicomputer or a microcomputer with sufficient memory to execute the software required to reformat, transfer, and perform error checks on data between the CCU and FIDs, and to provide limited backup in the event of CCU failure. The CCC is used only in a large EMCS.

c. Operator's Console

A color CRT terminal with graphics display. It accepts operator commands, displays data and graphically displays systems controlled or monitored by the EMCS.

d. Command Line Mnemonic Interpreter (CLMI)

A prompting routine that allows the operator to perform control and monitoring operations by simple English-like keyboard commands from the operator's console.

e. System Terminal

A black and white (B/W) CRT terminal used to devlop programs, run diagnostics and support background processing.

f. Alarm and Logging Printers

Printers to provide a permanent copy of system operations and historical data.

g. Cartridge Disk System

A high-density random access mass storage device, with removable storage media.

h. Winchester Disk System

A high-density random access mass storage device, with a nonremovable, hermetically sealed storage media.

Note: Disk type and capacity is dependent upon the number of points controlled or monitored, and number and type of

energy conservation programs being implemented, and the amount of operator interaction required.

A large EMCS requires a disk system which has 100 percent spare space after the system is configured, plus a duplicate disk system. Also, a bulk loader is required; normally, floppy disks are used for this.

i. Floppy Disk Storage System

A medium-density random access storage device, with removable storage media.

j. External Uninterruptible Real Time Clock

A clock that is external to the CCU and CCC used to synchronize system clocks at regular intervals, with battery backup. A real time clock is required for all EMCS.

k. Failover Control Board

Switches CCU, CCC, and printers in the event of CCU or CCC failure into the backup mode of operation. The failover control board is required only when the CCC is used.

l. Nine-Track Magnetic Tape System

A high-density serial mass storage device, with removable storage media.

m. Field Interface Device (FID)

A microcomputer based device with memory, I/O, communications, and power supply. The FID provides an interface to the controlled equipment and environment, performs calculations and logical operations, accepts and processes CU commands, and is capable of stand-alone operation in the event of CCU, CCC, or communications link failure.

n. Multiplexer (MUX) Panel

A device which combines data from a number of points in the DE and communicates on a single channel. It also performs demultiplexing of commands received on a single channel. The MUX panel is functionally part of the FID that can be in the same enclosure or remotely located. It can be a hardwired device or a microprocessor based device.

G. ENERGY CONSERVATION PROGRAMS

1. GENERAL

The following is a description of software programs available for EMCS. It is borrowed largely from Reference 1.

Not all the programs listed here are recommended for the Ft. Riley installation. All were considered in the analysis, however.

2. SCHEDULED START/STOP

The scheduled start/stop program consists of starting and stopping equipment based on the time of day and day of week. Day of week refers to weekdays, Saturdays, Sundays, holidays, or any day which may have a different schedule of operation. Scheduled start/stop is the simplest of all EMCS functions to implement. This program provides the greatest potential for energy conservation by turning off equipment or systems during unoccupied hours. In addition to sending a start/stop command, it is important, although not mandatory to have a feedback signal indicating the status (on-off) of the controlled equipment. The feedback signal verifies that the command has

been carried out and provides the EMCS operator with an alarm when the equipment is locally started or stopped.

3. OPTIMUM START/STOP

The scheduled start/stop program described earlier can be refined by automatically adjusting the equipment operating schedule in accordance with space temperature and outside air (OA) temperature and humidity. HVAC systems are normally restarted prior to occupancy to cool down or heat up the space on a fixed schedule independent of OA and space conditions. The optimum start/stop program automatically starts and stops the system on a sliding schedule. The program automatically evaluates the thermal inertia of the structure, the capacity of the HVAC system to either increase or reduce space temperatures, and OA conditions. This accurately determines the minimum time of HVAC system operation needed to satisfy the space environmental requirements at the start of the occupied cycle.

4. DUTY CYCLING

Duty cycling program consists of shutting down mechanical/electrical equipment for predetermined short periods of time during normal operating hours. This function is normally only applicable to HVAC systems. Duty cycling

operation is based on the theory that HVAC systems seldom operate at peak design conditions. If the system is shut off for a short period of time, it has enough capacity to overcome the slight temperature drift which occurs during the shutdown period. Although the interruption does not reduce the energy required for space heating or cooling, it does reduce energy input to constant auxiliary loads such as fans and pumps. This function also reduces OA heating and cooling loads since the OA intake damper is closed (under local loop control) while an air handling unit is off. Systems are generally cycled off for some fixed period of time, typically 15 minutes, out of each hour of operation. The off period time and its frequency is program adjustable. The off time period is automatically increased or decreased in accordance with space conditions. When the duty cycle program is used in conjunction with the demand limiting program it is necessary to interlock the off time period for each piece of equipment to prevent starting and stopping of motors in excess of what is recommended by the NEMA Standard MG-1 for each motor size classification.

5. DEMAND LIMITING

Demand limiting consists of stopping electrical loads to prevent exceeding an electrical demand peak value (target). This

prevents an increase in electrical rates where demand oriented rate schedules apply. Peak demand contact values are established by the utility company using fixed demand intervals, sliding window intervals, and time of day schedule. Many complex schemes exist for reducing peak demand billings, however; all schemes continuously monitor current power demand and calculate the rate of change of the demand value in predicting future peak demand. When the predicted demand peak exceeds preset limits, predetermined scheduled electrical loads are shut off on a priority basis to reduce the connected load before the peak is exceeded. The demand limiting program is interlocked with the duty cycling program to prevent any one load from being cycled off or on during the wrong interval of time or an excessive number of times. The most commonly shed loads are HVAC systems. The reasoning used in the duty cycling program applies here; i.e., allow a temperature drift in the space by shutting off the HVAC equipment. Within a particular priority group, the order in which a load is shed is changed by the program so that after a load has been the first to be shed in a group, it is moved to last in the group and another load becomes first.

6. DAY/NIGHT SETBACK

The energy required for heating or cooling (where required for special types of occupancy) during unoccupied hours can be reduced by lowering the heating space temperature setpoint or raising the cooling space temperature setpoint. This applies only to facilities that do not operate 24 hours a day. Normally the space temperature can be reduced from the normal 65 degrees F winter inside design temperature to a 50 degrees F or 55 degrees F space temperature during the unoccupied hours. In spaces that require air conditioning during unoccupied hours the normal temperature setting can be reset upwards to a temperature that is compatible with the space special requirements. OA dampers for the HVAC system are closed when the equipment operates during the unoccupied periods in order to avoid imposing additional OA thermal loads.

7. DRY BULB ECONOMIZER

The utilization of an OA dry-bulb economizer cycle in air conditioning systems can be a cost effective conservation measure, depending on climatic conditions and the type of mechanical system. The dry-bulb economizer cycle utilizes OA to reduce the building's cooling system energy requirements. When

the OA dry-bulb temperature is above the changeover temperature, the local loop controls the operation of the outside air dampers, return air dampers, and relief air dampers. When the OA dry-bulb temperature is below the changeover temperature, the OA and return air dampers are positioned by EMCS in lieu of normal recirculation of space air to admit excess OA for free cooling. This program cannot be used where humidity control is required.

8. ENTHALPY ECONOMIZER

The utilization of an OA enthalpy program can be a cost effective energy conservation measure, depending on climatic conditions and the type of mechanical system. The enthalpy cycle utilizes OA to reduce the building's cooling requirements when the enthalpy (total heat content) of the OA is less than that of the return air. When the OA enthalpy is below the return air enthalpy, the OA and return air damper are positioned to admit up to 100 percent OA for free cooling. When the OA enthalpy is above the return air enthalpy, the dampers are repositioned to allow minimum OA.

9. VENTILATION AND RECIRCULATION

The ventilation and recirculation program controls the operation of the OA dampers when the introduction of OA would impose an additional thermal load during warm-up or cool-down cycles prior to occupancy of the building. This program can also be used in those facilities which maintain environmental conditions for electronic equipment or other humidity-sensitive devices during the building unoccupied periods. During the unoccupied periods, the OA dampers remain closed. During the building occupied cycle, the OA, return and relief dampers are under local loop control. This program operates in conjunction with the scheduled start/stop and optimum start/stop programs prior to building occupancy.

10. HOT DECK/COLD DECK TEMPERATURE RESET

The hot deck/cold deck temperature reset program can be applied to dual duct systems and multizone HVAC systems. These systems utilize a parallel arrangement of heating and cooling surfaces, commonly referred to as hot and cold decks, for providing heating and cooling capabilities simultaneously. The hot and cold air streams are combined in mixing boxes or plenums to satisfy the individual space temperature requirements. In the absence of optimization controls, these systems mix the two air

streams to produce the desired temperature. While the space temperature may be acceptable, a greater difference between the temperatures of the hot and cold decks, will result in more inefficent system operation. This program selects the areas with the greatest heating and cooling requirements, and establishes the minimum hot and cold deck temperature differentials which will meet the requirements, thus maximizing system efficiency. Space temperature sensors and mixing box or plenum damper positions are used to determine the minimum and maximum cold deck temperatures necessary to satisfy the space temperature requirements during the building occupied period.

11. STEAM BOILER OPTIMIZATION

This program is for multiple boiler installations only. The steam boiler optimization program can be implemented in heating plants with multiple boilers. Optimization of boiler plants can be accomplished through the selection of the most efficient boiler(s) to satisfy the heating load. Boiler operating data must be obtained from the manufacturer, or developed by monitoring fuel input as a function of the steam output. Determination of boiler efficiency also takes into account the heat content of the condensate return and makeup water. Based on the efficiency curves, fuel input vs. steam output, the

boilers with the highest efficiency can be selected to satisfy the heating load. Burner operating efficiency can be monitored by measuring the O_2 in each boiler flue.

12. HOT WATER BOILER OPTIMIZATION

This program is for multiple boiler installations only. Hot water boiler optimization can be implemented in heating plants with multiple boilers. The techniques and considerations are the same as discussed in (paragraph 11).

13. HOT WATER OA RESET

Hot water heating systems, whether the hot water is supplied by a boiler or a converter, are generally designed to supply hot water at a fixed temperature. Depending on the system design, the hot water supply temperature can be reduced, as the heating requirements for the facility decrease, because of increased OA temperatures. A reduction in hot water supply temperature results in reduction of heat loss from equipment and piping. To implement this program, the temperature controller for the hot water supply is reset as a function of OA temperature.

14. CHILLER OPTIMIZATION

This program is for multiple chiller installations only. The chiller optimization program can be implemented in chilled water plants with multiple chillers. Based on chiller operating data and the energy input requirements obtained from the manufacturer for each chiller, the program will select the chiller or chillers required to meet the load with the minimum energy consumption. When a chiller or chillers are started, chiller capacity must be limited (prevented from going to full load) for a predetermined period to allow the system to stabilize in order to determine the actual cooling load. Comparison of equipment characteristics vs. the actual operating chiller characteristics make it possible to determine when heat transfer surfaces need cleaning to maintain the highest efficiency. The program must follow the manufacturer's start-up and shutdown sequence requirements. Interlocks between chilled water pumps, condenser water pumps and chiller must be in accordance with the chiller manufacturer's requirements.

15. CHILLED WATER TEMPERATURE RESET

This program is for reciprocating and centrifugal chillers only. The energy required to produce chilled water in a reciprocating or centrifugal refrigeration machine is directly related to

leaving chilled water temperature. The refrigerant suction temperature is also related to the leaving water temperature; the higher the temperature, the lower the energy input per ton of refrigeration. Chiller discharge water temperature is selected for peak design times; therefore, chilled water temperatures can be elevated during nonpeak design hours to the maximum which will still satisfy space cooling requirments. The program resets chilled water temperature until the required space temperature can no longer be maintained. This determination is made by monitoring positions of the chilled water valves on various cooling systems or by monitoring space temperatures.

16. CONDENSER WATER TEMPERATURE RESET

The energy required to operate systems is directly related to the temperature of the condenser water temperature entering the machine. Conventionally, heat rejection systems are designed to produce a specified condenser water temperature such as 85 degrees F at peak wet-bulb temperatures. In many instances, automatic controls are provided to maintain a specified temperature at conditions other than peak wet-bulb temperatures. In order to optimize the performance of refrigeration systems, condenser water temperature can be reset downward when OA wet-

bulb temperature will produce lower condenser water temperature. The program must incorporate manufacturer requirements governing the acceptable condenser water temperature range.

17. CHILLER DEMAND LIMIT

This program is for centrifugal chillers only. Centrifugal water chillers are normally factory equipped with an adjustable control system which limits the maximum available cooling capacity; thus, the power the machine can use. An interface between the FID and the chiller controls allows EMCS to reduce the maximum available cooling capacity in several fixed steps in a demand limiting situation, thereby reducing the electric demand without completely shutting down the chiller. The method of accomplishing this function varies with the manufacturer of the chiller. The chiller percent capacity can be obtained by monitoring the chiller current input. When a chiller is selected for demand limiting, a single-step signal is transmitted, reducing the chiller limit adjustment by a fixed amount. The chiller demand limit adjustment can be performed by adding or deleting resistance to the control circuit, shunting out taps of auto transformers in the control circuit or by resetting the control air pressure to the chiller vane operator. As further need arises, additional stop signals can be

transmitted until the demand limiting situation is corrected. Extreme caution must be exercised when applying this program, since incorrect control can cause the refrigeration machine to operate in a surge condition, potentially causing it considerable damage. The chiller manufacturer's recommended minimum cooling capacity limit must be incorporated into the program logic. In general, surges occur in chillers at loads less than 20 percent of the rated capacity. This program is used in conjunction with the demand limiting program and, therefore, each chiller demand control step must be assigned an equipment priority level.

18. LIGHTING CONTROL

Time scheduled operation of lighting consists of turning on and off lights, based on the time of day and the day of week. Additional off commands should be generated once an hour to assure that lights are off in the event that personnel turn lights on without authorization after hours. An alternative to this program is to initiate only the off function and require that the lights be turned on manually. Breakers connected to emergency lights must not be disconnected.

19. OUTDOOR AIR START/STOP

The outdoor air start/stop program calls for switching of equipment based on outdoor air temperature or humidity. Just as with the scheduled start/stop program, an equipment status signal can be important in verifying that the switch command has been properly executed.

* * * * *

PART II – COST-BENEFIT ANALYSIS

PART II

COST-BENEFIT ANALYSIS

A. METHOD OF ANALYSIS

The approach to this EMCS feasibility study is a four-step procedure described in References 1 and 2.

Step one is a tentative listing of buildings which are most likely to benefit from the proposed EMCS. The Facilities Engineer and Burns & McDonnell prepared a list of 194 such buildings.

Step 2 is an information search and field survey. The information search embodies a review of utility records, drawings; specifications and equipment manuals. Using this information pool as a guide, each of the 194 buildings was visited by a Burns & McDonnell survey team. The team checked such factors as motor horsepowers, equipment condition and occupancy schedules. In this manner, the information pool was verified and supplemented to the best possible extent.

Step 3 is a preliminary analysis. Each building is scrutinized and ways to save energy are identified. Costs are estimated too. The

preliminary analysis gives a rough idea of the EMCS--costs, benefits, system size; number of buildings, and so on.

Step 4 is a reevaluation of the EMCS. Each building is examined again, and the initial estimates are refined.

B. SUMMARY

Table II-1 summarizes our results. Energy savings were estimated with the aid of Burns & McDonnell computer models, and the methods recommended in References 4, 5, 6 and 10. Costs for points were based on manufacturers' estimates presented earlier in Table I-2, page I-23. The "Existing Controls" listings are costs to modify or correct local controls. The "DTM" costs are for new phone lines which are expected to be installed as part of the EMCS project. The E/C ratios were computed in accordance with Reference 1, Chapter 7.

Table II-2 indicates buildings not recommended for the EMCS.

Table II-3 is another listing of the same buildings entered in Table II-1; the buildings are ranked by E/C ratio.

(Continued on Page II-127)

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
3	Chapel	4640	–	2000	6640	65	103	–	168	3	19
32	Field House	11,340	–	870	12,210	38	1670	–	1708	9	67
34	Admin.	8240	–	870	9110	59	1064	–	1123	7	73
37	Admin.	33,080	–	870	33,950	568	950	–	1518	30	50
40	Barracks	16,640	–	870	17,510	863	599	–	1462	15	75
46	Child Care	10,040	–	870	10,910	465	272	–	737	9	67
70	Finance	6940	–	870	7810	11	541	–	552	5	45
72	Band Training	3840	–	870	4710	–	155	–	155	2	21
75	Red Cross	3840	–	870	4710	10	139	–	149	2	20
89	Barracks	20,630	–	870	21,500	406	113	–	519	19	53
90	Barracks	14,390	–	870	15,260	491	56	–	547	14	55
91	Barracks	20,630	–	870	21,500	406	113	–	519	19	53
92	HQ	3690	–	870	4560	–	266	–	266	2	34
93	Barracks	20,630	–	870	21,500	406	113	–	519	19	53
94	Barracks w/Mess	22,330	–	870	23,200	1797	–	80	1877	20	74
108	Post HQ	13,290	–	2000	15,290	–	1073	–	1073	12	75
126	Warehouse	5790	–	870	6660	139	545	–	684	4	52
128	Chapel	7090	–	2000	9090	65	103	–	168	6	19
149	Barracks	21,180	2000	870	24,050	426	169	–	595	19	31
163	Theater	7390	–	870	8260	865	303	–	1168	6	74
165	Barracks	21,180	2000	870	24,050	426	169	–	595	19	31
184	Rec. Ctr.	12,940	–	870	13,810	255	366	–	621	10	40
201	Admin.	6440	–	870	7310	–	3397	–	3397	5	118
205	Motor Rep. Shop	5890	–	870	6760	–	854	–	854	4	73
255	Officer's Club	39,770	–	3530	43,300	830	374	–	1204	37	39

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
296	Marksmanship	5890	–	3620	9510	–	319	–	319	4	26
315	Barracks w/Mess	12,640	–	2000	14,640	360	48	–	408	12	38
355	HQ	4990	–	870	5860	–	139	–	139	3	19
487	BOQ	15,590	–	870	16,460	450	–	–	450	14	41
495	Dental Clinic	12,390	–	870	13,260	NA	NA	NA	NA	11	NA
801	Admin.	15,240	–	870	16,110	372	920	–	1292	14	74
860	Flight Training	4990	–	870	5860	109	156	–	265	3	32
864	Hangar	7890	–	870	8760	32	1646	–	1678	6	94
866	Hangar	9540	–	870	10,410	32	1646	–	1678	8	94
1470	Army Reserves	11,040	–	4100	15,140	–	–	377	377	10	25
1950	Salvage	7790	–	4100	11,890	74	–	762	836	6	42
1980	Field House	9390	–	4100	13,490	7	1052	–	1059	7	42
5302	Post Office	4840	–	4900	9740	236	271	–	507	3	31
5315	Chapel	11,540	–	4900	16,440	463	392	–	855	10	35
6620	NCO Club	25,930	2000	870	28,800	598	285	–	883	24	28
6910	Run-in Chef	19,590	–	870	20,460	1257	–	–	1257	18	39
6914	Main Px										
6940	Pool	9240	600	870	10,710	183	–	377	560	8	53
7004	Barracks w/Mess	14,640	–	870	15,510	346	84	–	430	14	35
7007	Barracks w/Mess	14,640	–	870	15,510	346	84	–	430	14	35
7010	Barracks w/Mess	14,640	–	870	15,510	346	84	–	430	14	35
7013	Barracks w/Mess	14,640	–	870	15,510	346	84	–	430	14	35
7017	HQ	5840	–	870	6710	–	110	–	110	4	15
7024	Gym	15,540	2000	870	18,410	211	1381	–	1592	14	101
7028	EM Club	7840	–	870	8710	47	144	–	191	6	21

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7031	Classroom	3950	–	870	4820	–	157	–	157	4	32
7033	Dispensary	9740	–	870	10,610	113	162	–	275	8	50
7034	Dispensary	6590	–	870	7460	113	162	–	275	5	34
7036	HQ	5100	–	890	5970	111	418	–	529	5	77
7044	Barracks w/Mess	31,030	2000	870	33,900	359	110	–	469	29	33
7046	Classroom	3950		870	4820	–	157	–	157	4	32
7047	Classroom	5840	–	870	6710	–	157	–	157	4	21
7048	HQ	3950	–	870	4820	–	110	–	110	4	24
7050	Barracks w/Mess	14,640	–	870	15,510	346	84	–	430	14	35
7053	Barracks w/Mess	14,640	–	870	15,510	346	84	–	430	14	35
7055	HQ	5840	–	870	6710	–	110	–	110	4	15
7086	Chapel	12,040	–	870	12,910	176	259	–	435	10	36
7210	Chiller Plant	59,740	–	870	60,610	3969	–	–	3969	41	37
7215	HQ	5840	–	870	6710	–	110	–	110	4	15
7224	Barracks w/Mess	31,030	2000	870	33,900	359	110	–	469	29	41
7227	Barracks w/Mess	31,030	2000	870	33,900	359	110	–	469	29	33
7230	Barracks w/Mess	31,030	2000	870	33,900	469	207	–	676	29	41
7233	Barracks w/Mess	31,030	2000	870	33,900	469	207	–	676	29	41
7243	Five Co. Admin. & Stor.	3950	–	870	4820	6	470	–	476	4	72
7245	Mess Hall	21,730	–	870	22,600	225	142	–	367	19	27
7253	Adj. General	9840	2000	870	12,710	36	1314	–	1350	8	68
7264	Rec. Ctr.	22,130	–	870	23,000	432	268	–	700	19	37
7270	HQ & Classroom	8590	–	870	9460	357	430	–	787	7	63
7285	Theater	12,840	–	870	13,710	1225	428	–	1653	11	70
7305	Spec. Weap. Clrm.	6990	–	2340	9330	114	418	–	532	5	40

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7350	Motor Rep. Shop	22,330	–	2340	24,670	32	1646	–	1678	16	53
7404	Barracks	12,890	–	870	13,760	1464	–	–	1464	11	84
7424	Barracks	12,890	–	870	13,760	1464	–	–	1464	11	84
7450	HQ	9590	–	870	10,460	279	418	–	697	8	51
7485	Bowling Ctr.	10,840	–	870	11,710	706	167	–	873	10	77
7500	Motor Rep. Shop	22,330	–	2340	24,670	32	1646	–	1678	16	53
7520	Motor Rep. Shop	22,330	–	2340	24,670	32	1334	–	1366	16	46
7602	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7604	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7606	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7608	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7610	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7612	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7614	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7616	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7618	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7620	HQ & Classroom	9240	–	870	10,110	357	430	–	787	8	79
7622	Admin.	16,740	–	870	17,610	849	888	–	1737	16	88
7624	Admin.	6700	–	870	7570	386	430	–	816	7	81
7626	Dispensary	8590	–	870	9460	106	151	–	257	7	37
7630	Admin. & Classroom	8590	–	870	9460	386	430	–	816	7	64
7632	Gym	16,840	–	870	17,710	211	1381	–	1592	16	122
7636	HQ	9590	–	870	10,460	279	418	–	697	8	51
7638	Admin. & Classroom	8590	–	870	9460	386	430	–	816	7	64
7640	Branch Px	5850	–	870	6720	106	152	–	258	6	43

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7642	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7644	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7646	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7648	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7650	Barracks	12,340	–	870	13,210	158	–	–	158	11	16
7652	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7654	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7656	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7658	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7665	Dental Clinic	7240	–	870	8110	864	880	–	1744	6	108
7670	Dental Clinic	10,490	–	870	11,360	2481	–	1072	3553	9	130
7720	Motor Rep. Shop	22,330	–	2340	24,670	32	1646	–	1678	16	53
7739	Redeye	10,590	–	100	10,690	119	171	–	290	9	34
7740	Motor Rep. Shop	22,330	–	2340	24,670	32	1646	–	1678	16	53
7760	Motor Rep. Shop	22,330	–	2340	24,670	32	1334	–	1366	16	46
7780	Motor Rep. Shop	22,330	–	2340	24,670	32	1334	–	1366	16	46
7802	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7804	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7806	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7808	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7810	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7812	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7814	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7816	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7818	Barracks	14,290	–	870	15,160	158	–	–	158	13	16

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7820	HQ & Classroom	7350	–	870	8220	357	430	–	787	8	79
7824	HQ	19,580	–	870	20,450	800	888	–	1688	17	87
7826	Dispensary	6700	–	870	7570	113	162	–	275	7	39
7832	Gym	13,650	–	870	14,520	211	1381	–	1592	14	122
7834	HQ	8380	–	870	9250	111	418	–	529	5	48
7836	HQ	17,690	–	870	18,560	800	888	–	1688	17	87
7840	Branch Px	12,390	–	870	13,260	106	152	–	258	11	43
7842	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7844	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7846	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7848	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7850	Barracks	14,290	–	870	15,160	158	–	–	158	13	16
7852	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7854	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7856	Mess Hall	18,980	–	870	19,850	225	142	–	367	16	27
7858	Five Co. Admin. & Stor.	23,330	–	870	24,200	138	470	–	608	21	38
7866	Theater	15,440	–	870	16,310	692	242	–	934	14	49
7900	Motor Repair Shop	22,330	–	2340	24,670	32	1334	–	1366	16	46
7920	Motor Repair Shop	88,390	–	2340	90,730	2293	9719	–	12,012	60	74
7940	Motor Repair Shop	22,330	–	2340	24,670	32	1334	–	1366	16	46
7960	Motor Repair Shop	22,330	–	2340	24,670	32	1646	–	1678	16	53
8002	Type B Barracks	8590	–	870	9460	199	–	–	199	7	18
8006	Type B Barracks	8590	–	870	9460	199	–	–	199	7	18
8008	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8010	Day Room	4750	–	870	5620	91	–	52	143	5	27

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
8012	Type B Barracks	8590	–	870	9460	199	–	–	199	7	18
8014	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8018	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8020	Day Room	8530	–	870	9400	91	–	52	143	5	18
8021	Five Co Admin & Supply	16,040	–	870	16,910	272	–	470	742	15	39
8023	Five Co Admin & Supply	16,040	–	870	16,910	272	–	470	742	15	39
8025	HQ & Classroom	14,140	–	870	15,010	585	–	894	1479	13	81
8037	HQ & Classroom	14,140	–	870	15,010	585	–	894	1479	13	81
8038	Type B Barracks	8590	–	870	9460	199	–	–	199	7	18
8040	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8042	Type B Barracks	8590	–	870	9460	199	–	–	199	7	18
8046	Day Room	4750	–	870	5620	91	–	52	143	5	27
8048	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8050	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8052	Type B Barracks	8590	–	870	9460	199	–	–	199	7	18
8054	Type A Barracks	6700	–	870	7570	100	–	–	100	7	21
8056	Day Room	8530	–	870	9400	91	–	52	143	5	18
8057	Five Co Admin & Supply	16,040	–	870	16,910	272	–	470	742	15	39
8059	Five Co Admin & Supply	16,040	–	870	16,910	272	–	470	742	15	39
8063	Mess Hall	10,930	–	870	11,800	1257	–	1035	2292	8	104
8065	Dispensary	7550	–	870	8420	106	–	151	257	8	48
8067	Branch Px	5550	–	870	6420	106	–	152	258	6	48
8069	Gym	31,930	–	870	32,800	564	–	1327	1891	29	70
8071	HQ	7440	–	870	8310	517	–	382	899	6	78
8073	Central Plant	96,410	–	870	97,280	350	–	7686	8036	78	45

Table II-1
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
8300	Motor Repair Shop	22,330	–	2340	24,670	32	–	1646	1678	16	53
8320	Motor Repair Shop	22,330	–	2340	24,670	32	–	1646	1678	16	53
8340	Motor Repair Shop	22,330	–	2340	24,670	32	–	1646	1678	16	53
8360	Motor Repair Shop	68,110	–	2340	70,450	49	–	2502	2551	47	24

Table II-1
COST/BENEFIT SUMMARY
TOTALS

Building Count

Number of buildings recommended for EMCS	179
Number of buildings not recommended	15
Total buildings examined	194

Point Count

Buildings	2299
OA points at FID's	18
Anzio Substation	1
Total	2318

Costs (Feb. 82 dollars)

Pts.	Exist. Controls	DTM	Total
$2,729,740	$20,600	$209,890	$2,960,230

Total costs for field hardware, modifications to existing controls, and DTM $2,960,230

Energy Savings (Mega BTU/Yr)

Electricity	Gas	Oil	Total
53,861	68,958	24,717	147,536

Total energy saved – 145,600 Mega BTU/Yr

Table II-2

BUILDINGS NOT RECOMMENDED FOR EMCS

No.	Function
71	Youth Ctr.
127	Commissary
144	Barracks
145	Carr Hall
146	Barracks
440	BOQ
441	BOQ
442	BOQ
480	Nurses BOQ
481	Nurses BOQ
839	Aviation Operations
863	Aviation Operations
5309	Will Hall
5322	Shoppette
6420	Telephone Exchange

Total 15 Buildings

Table II-3
BUILDINGS RANKED BY E/C RATIO

E/C Ratio	Building Number	Building Function
130	7670	Dental Clinic
122	7632	Gymnasium
	7832	Gymnasium
118	201	Administration
108	7665	Dental Clinic
104	8063	Mess Hall
101	7024	Gymnasium
94	864	Hangar
	866	Hangar
88	7622	Administration
87	7824	Headquarters
	7836	Headquarters
84	7404	Barracks
	7424	Barracks
81	7624	Administration & Classroom
	8025	Headquarters & Classroom
	8037	Headquarters & Classroom
79	7620	Headquarters & Classroom
	7820	Headquarters & Classroom
78	8071	Headquarters
77	7036	Headquarters
	7485	Bowling Center
75	40	Barracks
	108	Post Headquarters
74	94	Barracks w/Mess
	163	Theater
	801	Administration
	7920	Motor Repair Shop
73	34	Administration
	205	Motor Repair Shop
72	7243	Five Co. Administration & Storage
70	7285	Theater
	8069	Gymnasium
68	7253	Adj General
67	32	Field House
	46	Child Care
64	7630	Administration & Classroom
	7638	Administration & Classroom
63	7270	Headquarters & Classroom
55	90	Barracks
53	89	Barracks

Table II-3 (continued)
BUILDINGS RANKED BY E/C RATIO

E/C Ratio	Building Number	Building Function
	91	Barracks
	93	Barracks
	6940	Pool
	7350	Motor Repair Shop
	7500	Motor Repair Shop
	7720	Motor Repair Shop
	7740	Motor Repair Shop
	7960	Motor Repair Shop
	8300	Motor Repair Shop
	8320	Motor Repair Shop
	8340	Motor Repair Shop
52	126	Warehouse
51	7450	Headquarters
	7636	Headquarters
50	37	Administration
	7033	Dispensary
49	7866	Headquarters
48	7834	Headquarters
	8065	Dispensary
	8067	Branch PX
46	7520	Motor Repair Shop
	7760	Motor Repair Shop
	7780	Motor Repair Shop
	7900	Motor Repair Shop
	7940	Motor Repair Shop
45	8073	Central Plant
	70	Finance
43	7640	Branch PX
	7840	Branch PX
42	1950	Salvage
	1980	Field House
41	487	BOQ
	7224	Barracks w/Mess
	7230	Barracks w/Mess
	7233	Barracks w/Mess
40	184	Recreation Center
	7305	Special Weapons Classroom
39	255	Officer's Club
	6910	Run-in Chef
	6914	Main PX
	7826	Dispensary

Table II-3 (continued)
BUILDINGS RANKED BY E/C RATIO

E/C Ratio	Building Number	Building Function
	8021	Five Co. Administration & Storage
	8023	Five Co. Administration & Storage
	8057	Five Co. Administration & Storage
	8059	Five Co. Administration & Storage
38	315	Barracks w/Mess
	7602	Five Co. Administration & Storage
	7608	Five Co. Administration & Storage
	7652	Five Co. Administration & Storage
	7658	Five Co. Administration & Storage
	7802	Five Co. Administration & Storage
	7808	Five Co. Administration & Storage
	7852	Five Co. Administration & Storage
	7858	Five Co. Administration & Storage
37	7210	Chiller Plant
	7264	Recreation Center
	7626	Dispensary
36	7086	Chapel
35	5315	Chapel
	7004	Barracks w/Mess
	7007	Barracks w/Mess
	7010	Barracks w/Mess
	7013	Barracks w/Mess
	7050	Barracks w/Mess
	7053	Barracks w/Mess
34	92	Headquarters
	7034	Dispensary
34	7739	Redeye
33	7044	Barracks w/Mess
	7227	Barracks w/Mess
32	860	Barracks w/Mess
	7031	Classroom
	7046	Classroom
31	149	Barracks
	165	Barracks
	5302	Post Office
27	7245	Mess Hall
	7604	Mess Hall
	7606	Mess Hall
	7654	Mess Hall
	7656	Mess Hall
	7804	Mess Hall

Table II-3 (continued)
BUILDINGS RANKED BY E/C RATIO

E/C Ratio	Building Number	Building Function
	7806	Mess Hall
	7859	Mess Hall
	7856	Mess Hall
	8010	Day Room
	8046	Day Room
26	296	Marksmanship
25	1470	Army Reserves
24	7048	Headquarters
	8360	Motor Repair Shop
21	72	Band Training
	7028	EM Club
	7047	Classroom
	8008	Type A Barracks
	8014	Type A Barracks
	8018	Type A Barracks
	8040	Type A Barracks
	8048	Type A Barracks
	8050	Type A Barracks
	8054	Type A Barracks
20	75	Red Cross
19	3	Chapel
	128	Chapel
	355	Headquarters
18	8002	Type B Barracks
	8006	Type B Barracks
	8012	Type B Barracks
	8020	Day Room
	8038	Type B Barracks
	8042	Type B Barracks
	8052	Type B Barracks
	8056	Day Room
16	7610	Barracks
	7612	Barracks
	7614	Barracks
	7616	Barracks
	7618	Barracks
	7642	Barracks
	7644	Barracks
	7646	Barracks
	7648	Barracks
	7650	Barracks

Table II-3 (continued)
BUILDINGS RANKED BY E/C RATIO

E/C Ratio	Building Number	Building Function
	7810	Barracks
	7812	Barracks
	7814	Barracks
	7816	Barracks
	7818	Barracks
	7842	Barracks
	7844	Barracks
	7846	Barracks
	7848	Barracks
	7850	Barracks
15	7017	Headquarters
	7055	Headquarters
	7215	Headquarters
	178 Bldgs	

TABLE II-4
POINT LIST

LEGEND:

TEMP = temperature sensor (analog)	AL/C = alarm contactor (binary)
PRESS = pressure sensor (analog)	CPA = control point adjustment (analog)
FLOW = flow sensor (analog)	KWH = kW-hr readout (analog)
S/S = start/stop switch (binary)	TL = tank level sensor (analog)
STAT = status indicator (binary)	

CHAPEL 3

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU (Stm, DX)				1	1	
Discharge Air	1					
Space	1					

Total of 3 Points and 1 MUX

KING FIELD HOUSE 32

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Self Contnd. AC-2, AC-3				1		
UH-1 (Stm only)				1	1	
UH-3 (Stm only)				1	1	
UH-2, 4, 5, 6 (Stm only)				1		
Space	4					

Total of 8 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

GENERAL INSTRUCTION BUILDING 34

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HV-1 (Stm)				1	1	
Space	2					

Total of 7 Points and 1 MUX

ADMIN. & PX 37

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
CHW Pump				1	1	
AHU-1 (CHW only)				1	1	
AHU-2 (CHW only)				1	1	
AHU-3 (CHW only)				1	1	
AHU-4 (CHW only)				1	1	
AHU-5 (CHW only)				1	1	
AHU-6 (CHW only)				1	1	
AHU-7 (CHW only)				1	1	
AHU-8 (DX only)				1	1	
Self Contnd. AC-1				1	1	
Self Contnd. AC-2				1	1	
Self Contnd. AC-3				1	1	
Self Contnd. AC-4				1	1	
Self Contnd. AC-5				1	1	
Space	12					

Total of 30 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 40

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm CHW, 4 Zones)				1	1	
Hot/Cold Deck	2					
AHU-2 (Stm CHW, 4 Zones)				1	1	
Hot/Cold Deck	2					
ASU-1 (Stm, CHW)				1	1	
ASU-2 (Stm, CHW)				1	1	
ASU-3 (Stm, CHW)				1	1	
ASU-9 (Stm, only)				1	1	
CHW	1					

Total of 15 Points and 1 MUX

CHILD CARE CENTER 46

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
AHU-1 (HW, CHW)				1	1	
Discharge Air	1					
AHU-2 (HW, CHW)				1	1	
Discharge Air	1					
CHW/HW	1					
Space	2					

Total of 9 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

FINANCE 70

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
HW Pump (1/6 hp)				1	1	
Space	2			1	1	

Total of 5 Points and 1 MUX

BAND TRAINING 72

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
HW Pump (1/6 hp)				1	1	
Space	1					

Total of 2 Points and 1 MUX

RED CROSS 75

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Furnace				1	1	
Space	1					

Total of 2 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS 89

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW	1					
AHU-1 (2 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (2 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (4 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-4 (8 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
Space	4					

Total of 19 Points and 2 MUX's

BARRACKS 90

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW	1					
AHU-1 (5 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (5 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (Stm, CHW)				1	1	
Discharge Air	1					
Space	3					

Total of 14 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS 91

SIMILAR BUILDING 93

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW	1					
AHU-1 (2 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (2 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (8 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-4 (4 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
Space	4					

Total of 19 Points and 2 MUX's

RGT. BDE HQ 92

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
Space	1					

Total of 2 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS 93

SIMILAR BUILDING 91

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW	1					
AHU-1 (2 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (2 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (8 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-4 (4 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
Space	4					

Total of 19 Points and 2 MUX's

BARRACKS 94

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil Stm Blr (Kit.)				1	1	1
Gas Steam Boiler				1	1	1
CHW	1					
AHU-1 (5 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (5 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (Stm, CHW)				1	1	
AHU-8 (Stm)				1	1	
ASU-1 (Stm, CHW)				1	1	
ASU-2 (Stm, CHW)				1	1	
Space	5					

Total of 20 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

HQ 108

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
Self-Contained AC-1				1	1	
Self-Contained AC-2				1	1	
Self-Contained AC-3				1	1	
Self-Contained AC-4				1	1	
Space	4					

Total of 12 Points and 1 MUX

COMMISSARY WAREHOUSE 126

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
AHU (Stm, DX)				1	1	
Discharge Air	1					
Space	1					

Total of 4 Points and 1 MUX

CHAPEL 128

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Self-Contained AC-1, 2				1		
AHU-1, 2 (HW only)				1		
Space	4					

Total of 6 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS 149

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
CHW	1					
AHU-3 (Stm, CHW)				1	1	
AHU-4 (Stm, CHW)				1	1	
AHU-5 (Stm, CHW)				1	1	
AHU-1 (5 Zone, Stm)				1	1	
Hot/Cold Deck	2					
AHU-2 (5 Zone, Stm)				1	1	
Hot/Cold Deck	2					
Space	5					

Total of 19 Points and 2 MUX's

THEATER 163

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU-1 (DX, Steam)				1	1	
Discharge Air	1					
AHU-2 (DX only)				1	1	
Discharge Air	1					
Space	2					

Total of 6 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS 165

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
CHW	1					
AHU-1 (5 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (5 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (Stm, CHW)				1	1	
AHU-4 (Stm, CHW)				1	1	
AHU-5 (Stm, CHW)				1	1	
Space	5					

Total of 19 Points and 1 MUX

RECREATION CENTER 184

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1, 2				1		
AHU (HW, CHW)				1	1	
Fan Coil Units				1		
CHW	1					
Space	3					
HW	1					

Total of 10 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

ADMINISTRATION 201

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
AHU-1, 2, 3, 4 (Stm)				1		
Space	3					

Total of 5 Points and 1 MUX

MOTOR REPAIR SHOP 205

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
Stm Unit Heaters				1		
Space	1					

Total of 4 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

OFFICER'S CLUB 255

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler-1				1	1	1
CHW Pump				1	1	
AHU-1 (HW, CHW)				1	1	
Discharge Air	1					
AHU-2 (HW, CHW)				1	1	
Discharge Air	1					
AHU-3 (HW, CHW)				1	1	
Discharge Air	1					
AHU-4 (HW, CHW)				1	1	
Discharge Air	1					
AHU-5 (HW, CHW)				1	1	
Discharge Air	1					
CHW	1					
HW	1					
AHU-6 (HW, CHW)				1	1	
Discharge Air	1					
AHU-7 (HW, CHW)				1	1	
Discharge Air	1					
AHU-9 (HW, CHW)				1	1	
Discharge Air	1					
AHU-10 (HW, CHW)				1	1	
Discharge Air	1					
AHU-11 (HW, CHW)				1	1	
Discharge Air	1					
MAH (No Coil)				1	1	
Discharge Air	1					
Space	10					

Total of 37 Points and 3 MUX's

TABLE II-4 POINT LIST: (continued)

MARKSMANSHIP TRAINING 296

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1		1
Steam UH's				1	1	
Space	1					

Total of 4 Points and 1 MUX

BARRACKS W/MESS 315

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas HW Boiler-2				1	1	1
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
ASU-2 (Stm, CHW)				1	1	
Discharge Air	1					
CHW	1					
Space	3					

Total of 12 Points and 1 MUX

HQ 355

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					

Total of 3 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BOQ 487

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
CHW Pump				1	1	
AHU-1 (2 Zone, CHW)				1	1	
AHU-2 (2 Zone, CHW)				1	1	
AHU-3 (2 Zone, CHW)				1	1	
AHU-4 (2 Zone, CHW)				1	1	
AHU-5 (2 Zone, CHW)				1	1	
AHU-6 (2 Zone, CHW)				1	1	
Space	6					
HW	1					

Total of 14 Points and 1 MUX

DENTAL CLINIC 495

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
Air Cooled Chiller	1			1	1	
CHW Pump				1	1	
HW Pump				1	1	
AHU (DD, HW, CHW)				1	1	
Hot/Cold Duct	2					
Space	1					
HW Convertor	1					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

HQ 801

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm, DX)				1	1	
AHU-2				1	1	
AHU-3 (Stm, DX)				1	1	
AHU-4 (Stm)				1	1	
SCAC-1				1	1	
Space	5					

Total of 14 Points and 1 MUX

AIRCRAFT TRAINING 860

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU-1 (HW, DX)				1	1	
AHU-2 (HW, DX)				1	1	
Space	1					

Total of 3 Points and 1 MUX

HANGAR 864

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
HW Pump				1	1	
HW	1					
UH-1, 2, 3, 4 Steam Radiators				1		
Space	1					

Total of 6 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

HANGAR 866

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW	1					
HW Pump-1, 2				1		
UH-1, 2, 3, 4				1		
Space	1					

Total of 8 Points and 1 MUX

ARMY RESERVES 1470

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil HW Boiler-1				1	1	1
Oil HW Boiler-2				1	1	1
HW Pump-1				1	1	
AHU (HW, DX)				1	1	
HW	1					
Space	3					

Total of 10 Points and 1 MUX

SALVAGE 1950

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil HW Boiler				1	1	
HW Pump				1	1	
AHU (DX)				1	1	
HW	1					
Space	2					

Total of 6 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

FIELD HOUSE 1980

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Furnace-1, 2				1		
Gas Furnace-3, 4, 5, 6,				1		
and AHU (DX)				1	1	
Gas Furnace-7				1	1	
Space	3					

Total of 7 Points and 1 MUX

POST OFFICE 5302

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
HW Pump-1,2				1		
AHU (4 Zones, HW, DX)				1	1	
Space	1					

Total of 3 Points and 1 MUX

CHAPEL 5315

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW	1					
CHW Pump-1, 2, 3				1		
AHU (HW, CHW)						
Discharge Air	1					
FCU-group-1				1		
FCU-group-2				1		
Space	3					

Total of 10 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

NCO CLUB 6620

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW	1					
CHW	1					
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (7 Zone, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2				1	1	
Discharge Air	1					
AHU-3				1	1	
Discharge Air	1					
AHU-4				1	1	
Discharge Air	1					
AHU-5				1	1	
Discharge Air	1					
Space	5					

Total of 24 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MAIN PX 6910 & 6914

ITEM	TEMP	PRESS	FLOW	CPA	S/S	STAT	AL/C
Gas HW Boiler					1	1	1
Recip. Chiller-1, 2 & ACC-1, 2, 3, 4, & CHW Pump-1, 2					1		
HW Pump-1, 2					1		
CHW	1			1			
AC-1 (HW, CHW)					1	1	
AC-2 (HW, CHW)					1	1	
AC-3 (HW, CHW)					1	1	
AC-4 (6 Zone, HW, CHW)					1	1	
AC-5 (6 Zone, HW, CHW)					1	1	
AC-6					1	1	
Space	6						

Total of 18 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

POOL 6940

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil HW Boiler-1				1	1	1
Oil HW Boiler-2				1	1	1
Oil HW Boiler-3				1	1	1
AHU-2 (HW)				1	1	
Space	1					

Total of 8 Points and 1 MUX

BARRACKS W/MESS 7004

SIMILAR BUILDINGS 7007, 7010, 7013, 7050, 7053

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-3				1	1	
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (3 Zone, Stm only)				1	1	
Hot/Cold Deck	2					
Space	2					
HW	1					
CHW	1					

Total of 14 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7007

SIMILAR BUILDINGS 7004, 7010, 7013, 7050, 7053

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-3				1	1	
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (3 Zone, Stm only)				1	1	
Hot/Cold Deck	2					
Space	2					
HW	1					
CHW	1					

Total of 14 Points and 1 MUX

BARRACKS W/MESS 7010

SIMILAR BUILDINGS 7004, 7007, 7013, 7050, 7053

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-3				1	1	
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (3 Zone, Stm only)				1	1	
Hot/Cold Deck	2					
Space	2					
HW	1					
CHW	1					

Total of 14 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7013

SIMILAR BUILDINGS 7004, 7007, 7010, 7050, 7053

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-3				1	1	
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (3 Zone, Stm only)				1	1	
Hot/Cold Deck	2					
Space	2					
HW	1					
CHW	1					

Total of 14 Points and 1 MUX

BN HQ 7017

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

GYM 7024

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Stm Blr (Spc. Heat)				1	1	
Gas HW Blr (Dom. HW)				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2				1	1	
Discharge Air	1					
HV-3				1	1	
Discharge Air	1					
HV-4				1	1	
Discharge Air	1					
HV-5				1	1	
Discharge Air	1					
Space	2					

Total of 14 Points and 1 MUX

EM CLUB 7028

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
CHW Pump				1	1	
Space	1					
HW	1					
CHW	1					

Total of 6 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BN CLASSROOM 7031

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points with MUX at 7028

ADMINISTRATION 7033

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
HW Pump				1	1	
AHU-1 (HW, DX)				1	1	
Discharge Air	1					
AHU-2 (Self-Cont. AC-no heat)				1	1	
Discharge Air	1					
HW	1					
Space	1					

Total of 8 Points and 1 MUX

DENTAL CLINIC 7034

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
AHU (3 Zone, Stm, DX)				1	1	
Hot/Cold Deck	2					
Space	1					

Total of 5 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

HQ 7036

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump-1				1	1	
HW Pump-2				1	1	
Space	1					
HW	1					

Total of 5 Points with MUX at 7034

BARRACKS W/MESS 7044

SIMILAR BUILDINGS 7224, 7227, 7230, 7233

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
AHU-6 (CHW only)				1	1	
Discharge Air	1					
AHU-7 (CHW only)				1	1	
Discharge Air	1					
HW Pump-1				1	1	
HW Pump-2				1	1	
HW	1					
CHW	1					
Space	7					

Total of 29 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BN CLASSROOM 7046

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points with MUX at 7047

BN CLASSROOM 7047

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points and 1 MUX

BN HQ 7048

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points with MUX at 7047

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7050

SIMILAR BUILDINGS 7004, 7007, 7010, 7013, 7053

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-3				1	1	
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (3 Zone, Stm only)				1	1	
Hot/Cold Deck	2					
Space	2					
HW	1					
CHW	1					

Total of 14 Points and 1 MUX

BARRACKS W/MESS 7053

SIMILAR BUILDINGS 7004, 7007, 7010, 7013, 7050

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-3				1	1	
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (3 Zone, Stm only)				1	1	
Hot/Cold Deck	2					
Space	2					
HW	1					
CHW	1					

Total of 14 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BN HQ 7055

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points and 1 MUX

CHAPEL 7086

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
P-1 (CDW)				1	1	
P-2 (CDW)				1	1	
P-3 (HW)				1	1	
P-4 (Dual Temp)				1	1	
AC-1 (HW, DX)				1	1	
Discharge Air	1					
HW/CHW	1					
Space	2					

Total of 10 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

CHILLER PLANT 7210

ITEM	TEMP	PRESS	FLOW	CPA	KWH	S/S	STAT	AL/C
Centri. Chiller-1					1	1	1	
Centri. Chiller-2					1	1	1	
Centri. Chiller-3					1	1	1	
Cooling Tower (3-DS Fans)						6	6	
CHW Pump-1						1	1	
CHW Pump-2						1	1	
CHW Pump-3						1	1	
CDW Pump-1						1	1	
CDW Pump-2						1	1	
CDW Pump-7						1	1	
CHW	8		3	3				
CDW	6		3					

Total of 41 Points and 3 MUX's

BN HQ 7215

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump-1				1	1	
Space	1					
HW	1					

Total of 4 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7224

SIMILAR BUILDINGS 7044, 7227, 7230, 7233

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
AHU-6 (CHW only)				1	1	
Discharge Air	1					
AHU-7 (CHW only)				1	1	
Discharge Air	1					
HW Pump-1				1	1	
HW Pump-2				1	1	
HW	1					
CHW	1					
Space	7					

Total of 29 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7227

SIMILAR BUILDINGS 7044, 7224, 7230, 7233

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
AHU-6 (CHW only)				1	1	
Discharge Air	1					
AHU-7 (CHW only)				1	1	
Discharge Air	1					
HW Pump-1				1	1	
HW Pump-2				1	1	
HW	1					
CHW	1					
Space	7					

Total of 29 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7230

SIMILAR BUILDINGS 7044, 7224, 7227, 7233

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
AHU-6 (CHW only)				1	1	
Discharge Air	1					
AHU-7 (CHW only)				1	1	
Discharge Air	1					
HW Pump-1				1	1	
HW Pump-2				1	1	
HW	1					
CHW	1					
Space	7					

Total of 29 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BARRACKS W/MESS 7233

SIMILAR BUILDINGS 7044, 7224, 7227, 7230

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
AHU-1 (Stm, CHW)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
AHU-6 (CHW only)				1	1	
Discharge Air	1					
AHU-7 (CHW only)				1	1	
Discharge Air	1					
HW Pump-1				1	1	
HW Pump-2				1	1	
HW	1					
CHW	1					
Space	7					

Total of 29 Points and 2 MUX's

FIVE CO ADMIN & SUPPLY 7243

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
Space	1					
HW	1					

Total of 4 Points with MUX at 7245

TABLE II-4 POINT LIST: (continued)

MESS HALL 7245

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
CDW Pump				1	1	
HW Pump				1	1	
Din Rm AHU (Stm, CHW)				1	1	
Discharge Air	1					
AHU-1 (Stm only)				1	1	
Discharge Air	1					
AHU-2 (Stm only)				1	1	
Discharge Air	1					
AHU-3 (Stm only)				1	1	
Discharge Air	1					
CHW	1					
HW	1					
Space	4					

Total of 19 Points and 2 MUX's

ADJ GENERAL 7253

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler-1				1	1	1
Gas Steam Boiler-2				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
HW	1					
Space	1					

Total of 8 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

REC CTR 7264

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Stm Blr-1 (Sp. Ht)				1	1	
Gas Stm Blr-2 (Dom. HW)				1	1	
CHW Pump				1	1	
CDW Pump				1	1	
Rome Inn AHU (Stm only)				1	1	
Discharge Air	1					
Kitchen AHU (Stm, DX)				1	1	
Discharge Air	1					
AHU-1 (Stm, DX)				1	1	
Discharge Air	1					
AHU-2 (Stm, DX)				1	1	
Discharge Air	1					
AHU-3 (Stm, DX)				1	1	
Discharge Air	1					
Space	5					

Total of 19 Points and 2 MUX's

HQ & CLASSROOM 7270

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
HW Pump	1			1	1	
AHU (5 Zones, HW, DX)				1	1	
Hot/Cold Deck	2					
Space	1					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

THEATER 7285

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump-1				1	1	
HW Pump-2				1	1	
CDW Pump				1	1	
AHU-1 (HW, DX)				1	1	
Discharge Air	1					
AHU-2 (HW, DX W/COMP)				1	1	
Discharge Air	1					
HW	1					
Space	2					

Total of 11 Points and 1 MUX

SPECIAL WEAPONS CLASSROOM 7305

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
Dual Temp Pump				1	1	
HW Pump				1	1	
Space	1					
HW/CHW	1					

Total of 5 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7350

SIMILAR BUILDINGS 7500, 7520, 7720, 7740, 7760, 7780, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7404

SIMILAR BUILDING 7424

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Blr-1 (Spc Ht)				1	1	
Gas HW Blr-2 (Dom HW)				1	1	
HW Pump-1				1	1	
HW Pump-2				1	1	
AHU-1 (HW, CHW)				1	1	
Discharge Air	1					
AHU-2 (HW, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	1					

Total of 11 Points and 1 MUX

BARRACKS W/OUT MESS 7424

SIMILAR BUILDING 7404

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Blr-1 (Spc Ht)				1	1	
Gas HW Blr-2 (Dom HW)				1	1	
HW Pump-1				1	1	
HW Pump-2				1	1	
AHU-1 (HW, CHW)				1	1	
Discharge Air	1					
AHU-2 (HW, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	1					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

HQ 7450

SIMILAR BUILDING 7636

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump				1	1	
Dual Temp Pump				1	1	
AHU (Dual Temp Coil)				1	1	
Discharge Air	1					
HW/CHW	1					
Space	1					

Total of 8 Points and 1 MUX

BOWLING CENTER 7485

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump				1	1	
AHU-1 (DD, HW, DX)				1	1	
Hot/Cold Duct	2					
HW	1					
Space	3					

Total of 10 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7500

SIMILAR BUILDINGS 7350, 7520, 7720, 7740, 7760, 7780, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7520

SIMILAR BUILDINGS 7350, 7500, 7720, 7740, 7760, 7780, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7602

SIMILAR BUILDINGS 7608, 7652, 7658, 7802, 7808, 7852, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7604

SIMILAR BUILDINGS 7606, 7654, 7656, 7804, 7806, 7854, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7606

SIMILAR BUILDINGS 7604, 7654, 7656, 7804, 7806, 7854, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7608

SIMILAR BUILDINGS 7602, 7652, 7658, 7802, 7808, 7852, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

BARRACKS W/OUT MESS 7610

SIMILAR BUILDINGS 7612, 7614, 7616

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7612

SIMILAR BUILDINGS 7610, 7614, 7616

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

BARRACKS W/OUT MESS 7614

SIMILAR BUILDINGS 7610, 7612, 7616

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7616

SIMILAR BUILDINGS 7610, 7612, 7614

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

BARRACKS W/OUT MESS 7618

SIMILAR BUILDINGS 7642, 7644, 7646, 7648, 7650

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

DENTAL CLINIC 7620

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump				1	1	
AHU (5 Zones, HW, DX)				1	1	
Hot/Cold Deck	2					
Space	1					
HW	1					

Total of 8 Points and 1 MUX

BN ADMIN 7622

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (3 Zn Wild HW, CHW)				1	1	
Hot/Cold Deck	2					
AHU-2 (5 Zn Wild HW, CHW)				1	1	
Hot/Cold Deck	2					
AHU-3 (3 Zn Wild HW, CHW)				1	1	
Hot/Cold Deck	2					
HW	1					
CHW	1					
Space	1					

Total of 16 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BN ADMIN & CLASSROOM 7624

SIMILAR BUILDINGS 7630, 7638

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
AHU-1 (5 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
HW	1					
Space	1					

Total of 7 Points with MUX at 7630

DISPENSARY 7626

SIMILAR BUILDING 7826

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
AHU-1 (2 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
HW	1					
Space	1					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BN ADMIN & CLASSROOM 7630

SIMILAR BUILDINGS 7624, 7638

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
AHU-1 (5 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
HW	1					
Space	1					

Total of 7 Points and 1 MUX

GYM 7632

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Stm Boiler-1				1	1	1
Gas Stm Boiler-2				1	1	1
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
HV-3 (Stm only)				1	1	
Discharge Air	1					
HV-4 (Stm only)				1	1	
Discharge Air	1					
HV-5 (Stm only)				1	1	
Discharge Air	1					
Space	2					

Total of 16 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

HQ 7636

SIMILAR BUILDING 7450

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump				1	1	
Dual Temp Pump				1	1	
AHU (Dual Temp Coil)				1	1	
Discharge Air	1					
HW/CHW	1					
Space	1					

Total of 8 Points and 1 MUX

BN ADMIN & CLASSROOM 7638

SIMILAR BUILDINGS 7624, 7630

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
AHU-1 (5 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
HW	1					
Space	1					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BRANCH EXCHANGE 7640

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	
AHU-1 (Stm, DX)				1	1	
Discharge Air	1					
AHU-2 (Stm, DX)				1	1	
Discharge Air	1					
Space	1					

Total of 6 Points with MUX at 7636

BARRACKS W/OUT MESS 7642

SIMILAR BUILDINGS 7618, 7644, 7646, 7648, 7650

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7644

SIMILAR BUILDINGS 7618, 7642, 7646, 7648, 7650

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

BARRACKS W/OUT MESS 7646

SIMILAR BUILDINGS 7618, 7642, 7644, 7648, 7650

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7648

SIMILAR BUILDINGS 7618, 7642, 7644, 7646, 7650

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

BARRACKS W/OUT MESS 7650

SIMILAR BUILDINGS 7618, 7642, 7644, 7646, 7648

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
HW/CHW	1					
Space	4					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7652

SIMILAR BUILDINGS 7602, 7608, 7658, 7802, 7808, 7852, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7654

SIMILAR BUILDINGS 7604, 7606, 7656, 7804, 7806, 7854, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7656

SIMILAR BUILDINGS 7604, 7606, 7654, 7804, 7806, 7854, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7658

SIMILAR BUILDINGS 7602, 7608, 7652, 7802, 7808, 7852, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

DENTAL CLINIC 7665

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil Steam Boiler				1	1	1
AHU (6 Zn, Stm, DX)				1	1	
Hot/Cold Deck	2					
Space	1					

Total of 6 Points and 1 MUX

DENTAL CLINIC 7670

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil Steam Boiler				1	1	1
HW Pump				1	1	
AHU (DD, HW/CHW)	2			1	1	
Hot/Cold Duct	2					
Space	1					

Total of 9 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7720

SIMILAR BUILDINGS 7350, 7500, 7520, 7740, 7760, 7780, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOVING TARGET SIMULATOR 7739

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump-1				1	1	
HW Pump-2				1	1	
AHU-1 (3 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
HW-1	1					
HW-2	1					
Space	1					

Total of 9 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7740

SIMILAR BUILDINGS 7350, 7500, 7520, 7720, 7760, 7780, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7760

SIMILAR BUILDINGS 7350, 7500, 7520, 7720, 7740, 7780, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7780

SIMILAR BUILDINGS 7350, 7500, 7520, 7720, 7740, 7760, 7900, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7802

SIMILAR BUILDINGS 7602, 7608, 7652, 7658, 7808, 7852, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7804

SIMILAR BUILDINGS 7604, 7606, 7654, 7656, 7806, 7854, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7806

SIMILAR BUILDINGS 7604, 7606, 7654, 7656, 7804, 7854, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7808

SIMILAR BUILDINGS 7602, 7608, 7652, 7658, 7802, 7852, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7810

SIMILAR BUILDINGS 7844

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

BARRACKS W/OUT MESS 7812

SIMILAR BUILDINGS 7814, 7816, 7818, 7842, 7846, 7848, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7814

SIMILAR BUILDINGS 7812, 7816, 7818, 7842, 7846, 7848, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

BARRACKS W/OUT MESS 7816

SIMILAR BUILDINGS 7812, 7814, 7818, 7842, 7846, 7848, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7818

SIMILAR BUILDINGS 7812, 7814, 7816, 7842, 7846, 7848, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

ADMINISTRATION 7820

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump	1			1	1	
AHU (5 Zones, HW, DX)				1	1	
Hot/Cold Deck	2					
Space	1					

Total of 8 Points with MUX at 7836

TABLE II-4 POINT LIST: (continued)

BN HQ 7824

SIMILAR BUILDING 7836

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
CHW Pump				1	1	
HW Pump-1				1	1	
AC-1 (3 Zn, HW, CHW)				1	1	
Hot/Cold Deck	2					
AC-2 (5 Zn, CHW only)				1	1	
Hot/Cold Deck	2					
AC-3 (3 Zn, HW, CHW)				1	1	
Hot/Cold Deck	2					
HW	1					
CHW	1					
Space	3					

Total of 17 Points and 2 MUX's

DISPENSARY 7826

SIMILAR BUILDING 7626

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
HW Pump				1	1	
AHU-1 (2 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
HW	1					
Space	1					

Total of 7 Points with MUX at 7834

TABLE II-4 POINT LIST: (continued)

GYM 7832

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Stm Blr (Spc. Heat)						1
Gas HW Blr (Dom. HW)						1
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2				1	1	
Discharge Air	1					
HV-3				1	1	
Discharge Air	1					
HV-4				1	1	
Discharge Air	1					
HV-5				1	1	
Discharge Air	1					
Space	2					

Total of 14 Points with MUX at 7824

HQ 7834

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump				1	1	
HW/CHW	1					
Space	1					

Total of 5 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BN HQ 7836

SIMILAR BUILDING 7824

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	
CHW Pump				1	1	
HW Pump-1				1	1	
AC-1 (3 Zn, HW, CHW)				1	1	
Hot/Cold Deck	2					
AC-2 (5 Zn, CHW only)				1	1	
Hot/Cold Deck	2					
AC-3 (3 Zn, HW, CHW)				1	1	
Hot/Cold Deck	2					
HW	1					
CHW	1					
Space	3					

Total of 17 Points and 1 MUX

BRANCH EXCHANGE 7840

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
AHU-1 (MZ, HW, DX)				1	1	
Hot/Cold Deck	2					
AHU-2 (HW, DX)				1	1	
Discharge Air	1					
HW Pump				1	1	
HW	1					
Space	2					

Total of 11 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7842

SIMILAR BUILDINGS 7812, 7814, 7816, 7818, 7846, 7848, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

BARRACKS W/OUT MESS 7844

SIMILAR BUILDINGS 7810

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7846

SIMILAR BUILDINGS 7812, 7814, 7816, 7818, 7842, 7848, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

BARRACKS W/OUT MESS 7848

SIMILAR BUILDINGS 7812, 7814, 7816, 7818, 7842, 7846, 7850

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BARRACKS W/OUT MESS 7850

SIMILAR BUILDINGS 7812, 7814, 7816, 7818, 7842, 7846, 7848

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
DT Pump-1				1	1	
DT Pump-2				1	1	
DT Pump-3				1	1	
DT Pump-4				1	1	
DT Pump-5				1	1	
HW/CHW	1					
Space	5					

Total of 13 Points and 1 MUX

FIVE CO ADMIN & STORAGE 7852

SIMILAR BUILDINGS 7602, 7608, 7652, 7658, 7802, 7808, 7858

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7854

SIMILAR BUILDINGS 7604, 7606, 7654, 7656, 7804, 7806, 7856

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MESS HALL 7856

SIMILAR BUILDINGS 7604, 7606, 7654, 7656, 7804, 7806, 7854

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas Steam Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
HV-1 (Stm only)				1	1	
Discharge Air	1					
HV-2 (Stm only)				1	1	
Discharge Air	1					
AC-1 (Stm, CHW)				1	1	
Discharge Air	1					
AC-2 (Stm, CHW)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	2					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & STORAGE 7858

SIMILAR BUILDINGS 7602, 7608, 7652, 7658, 7802, 7808, 7852

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
CHW Pump				1	1	
HW Pump				1	1	
AHU-1 (CHW only)				1	1	
Discharge Air	1					
AHU-2 (CHW only)				1	1	
Discharge Air	1					
AHU-3 (CHW only)				1	1	
Discharge Air	1					
AHU-4 (CHW only)				1	1	
Discharge Air	1					
AHU-5 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	5					

Total of 21 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

THEATER 7866

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
HW Pump-3				1	1	
HW Pump-4				1	1	
AHU-1 (2 Zn, HW, DX)				1	1	
Hot/Cold Deck	2					
AHU-2 (Elec, DX)				1	1	
Discharge Air	1					
HW	1					
Space	2					

Total of 14 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7900

SIMILAR BUILDINGS 7350, 7500, 7520, 7720, 7740, 7760, 7780, 7940, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7920

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
CENT TECH SUPPLY						
Ten UH-2's				1		
Eight DH-1's				1		
EF-2, EF-13, & Eight EF-14's				1		
MAH-4				1	1	
Discharge Air	1					
AC-4, HF-4				1	1	
Discharge Air	1					
Space	1					
* WINGS C, D, & E (TYP.)						
Nineteen RH-1's				3		
Three RH-2's & One UH-1				3		
MAH-1				3	3	
Discharge Air	3					
HF-1				3	3	
Discharge Air	3					
HVAC-1, AC-1				3	3	
Discharge Air	3					
Eleven EF-1's & One EF-2, EF-3, EF-9, & EF-15				3		
Space	3					
SW WING						
Twenty-two RH-1's				1		
MAH-2				1	1	
Discharge Air	1					
HF-2				1	1	
Discharge Air	1					
HVAC-2, AC-2				1	1	
Discharge Air	1					
HVAC-3				1	1	
Discharge Air	1					
AC-3				1	1	
Discharge Air	1					
Eleven EF-4's & One EF-2 & EF-5				1		
Space	1					

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7920 (continued)

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
SE WING						
Twenty-two RH-1's				1		
MAH-3				1	1	
Discharge Air	1					
HF-3				1	1	
Discharge Air	1					
HVAC-4, AC-4				1	1	
Discharge Air	1					
Ten EF-4's & One EF-6, EF-7, EF-8 EF-11, & EF-15				1		
Space	1					

Total of 60 Points and 1 FID

*Each of the three wings to have 1/3 of the Points for each Item.

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7940

SIMILAR BUILDINGS 7350, 7500, 7520, 7720, 7740, 7760, 7780, 7900, 7960

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 7960

SIMILAR BUILDINGS 7350, 7500, 7520, 7720, 7740, 7760, 7780, 7900, 7940

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Gas HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

TYPE B BARRACKS 8002

SIMILAR BUILDINGS 8006, 8012, 8038, 8042, 8052

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points and 1 MUX

TYPE B BARRACKS 8006

SIMILAR BUILDINGS 8002, 8012, 8038, 8042, 8052

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

TYPE A BARRACKS 8008

SIMILAR BUILDINGS 8014, 8018, 8040, 8048, 8050, 8054

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8002

SERVICE MODULE 8010

SIMILAR BUILDINGS 8020, 8046, 8056

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU (Stm, CHW)				1	1	
Discharge Air	1					
CHW Pump				1	1	
CHW	1					
Space	1					

Total of 5 Points with MUX at 8006

TABLE II-4 POINT LIST: (continued)

TYPE B BARRACKS 8012

SIMILAR BUILDINGS 8002, 8006, 8038, 8042, 8052

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points and 1 MUX

TYPE A BARRACKS 8014

SIMILAR BUILDINGS 8008, 8018, 8040, 8048, 8050, 8054

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8020

TABLE II-4 POINT LIST: (continued)

TYPE A BARRACKS 8018

SIMILAR BUILDINGS 8008, 8014, 8040, 8048, 8050, 8054

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8020

SERVICE MODULE 8020

SIMILAR BUILDINGS 8010, 8046, 8056

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU (Stm, CHW)				1	1	
Discharge Air	1					
CHW Pump				1	1	
CHW	1					
Space	1					

Total of 5 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & SUPPLY 8021

SIMILAR BUILDINGS 8023, 8057, 8059

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
HV-101A				1	1	
Discharge Air	1					
HV-101B				1	1	
Discharge Air	1					
HV-102A				1	1	
Discharge Air	1					
HV-102B				1	1	
Discharge Air	1					
HV-102C				1	1	
Discharge Air	1					
HW/CHW	1					
Space	3					

Total of 15 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & SUPPLY 8023

SIMILAR BUILDINGS 8021, 8057, 8059

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
HV-101A				1	1	
Discharge Air	1					
HV-101B				1	1	
Discharge Air	1					
HV-102A				1	1	
Discharge Air	1					
HV-102B				1	1	
Discharge Air	1					
HV-102C				1	1	
Discharge Air	1					
HW/CHW	1					
Space	3					

Total of 15 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

BN ADMIN & CLASSROOM 8025

SIMILAR BUILDING 8037

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
No Boiler						
CHW Pump				1	1	
HW Pump				1	1	
* AC-1 (CHW only)				1	1	
Discharge Air	1					
* AC-2 (CHW only)				1	1	
Discharge Air	1					
* AC-3 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	3					

Total of 13 Points and 1 MUX

* There is only one CHW Valve serving all three AC's.

TABLE II-4 POINT LIST: (continued)

BN ADMIN & CLASSROOM 8037

SIMILAR BUILDING 8025

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
No Boiler						
CHW Pump				1	1	
HW Pump				1	1	
* AC-1 (CHW only)				1	1	
Discharge Air	1					
* AC-2 (CHW only)				1	1	
Discharge Air	1					
* AC-3 (CHW only)				1	1	
Discharge Air	1					
HW	1					
CHW	1					
Space	3					

Total of 13 Points and 1 MUX

* There is only one CHW Valve serving all three AC's.

TYPE B BARRACKS 8038

SIMILAR BUILDINGS 8002, 8006, 8012, 8042, 8052

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

TYPE A BARRACKS 8040

SIMILAR BUILDINGS 8008, 8014, 8018, 8048, 8050, 8054

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8038

TYPE B BARRACKS 8042

SIMILAR BUILDINGS 8002, 8006, 8012, 8038, 8052

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

SERVICE MODULE 8046

SIMILAR BUILDINGS 8010, 8020, 8056

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU (Stm, CHW)				1	1	
Discharge Air	1					
CHW Pump				1	1	
CHW	1					
Space	1					

Total of 5 Points with MUX at 8042

TYPE A BARRACKS 8048

SIMILAR BUILDINGS 8008, 8014, 8018, 8040, 8050, 8054

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8056

TABLE II-4 POINT LIST: (continued)

TYPE A BARRACKS 8050

SIMILAR BUILDINGS 8008, 8014, 8018, 8040, 8048, 8054

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8056

TYPE B BARRACKS 8052

SIMILAR BUILDINGS 8002, 8006, 8012, 8038, 8042

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

TYPE A BARRACKS 8054

SIMILAR BUILDINGS 8008, 8014, 8018, 8040, 8048, 8050

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
FCU's, Group A				1	1	
FCU's, Group B				1	1	
HW/CHW	1					
Space	3					

Total of 7 Points with MUX at 8052

SERVICE MODULE 8056

SIMILAR BUILDINGS 8010, 8020, 8046

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AHU (Stm, CHW)				1	1	
Discharge Air	1					
CHW Pump				1	1	
CHW	1					
Space	1					

Total of 5 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & SUPPLY 8057

SIMILAR BUILDINGS 8021, 8023, 8059

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
HV-101A				1	1	
Discharge Air	1					
HV-101B				1	1	
Discharge Air	1					
HV-102A				1	1	
Discharge Air	1					
HV-102B				1	1	
Discharge Air	1					
HV-102C				1	1	
Discharge Air	1					
HW/CHW	1					
Space	3					

Total of 15 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

FIVE CO ADMIN & SUPPLY 8059

SIMILAR BUILDINGS 8021, 8023, 8057

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
DT Pump				1	1	
HV-101A				1	1	
Discharge Air	1					
HV-101B				1	1	
Discharge Air	1					
HV-102A				1	1	
Discharge Air	1					
HV-102B				1	1	
Discharge Air	1					
HV-102C				1	1	
Discharge Air	1					
HW/CHW	1					
Space	3					

Total of 15 Points and 1 MUX

MESS HALL 8063

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
AH-1 (6 Zn, Stm, CHW)				1	1	
Hot/Cold Deck	2					
AH-2 (Stm)				1	1	
Discharge Air	1					
CHW	1					
Space	2					

Total of 8 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

DISPENSARY 8065

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
HW Pump				1	1	
CHW Pump				1	1	
AHU-1 (2 Zn, HW, CHW)				1	1	
Hot/Cold Deck	2					
HW	1					
CHW	1					
Space	1					

Total of 8 Points with MUX at 8063

BRANCH EXCHANGE 8067

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
CHW Pump-1				1	1	
AHU-1 (3 Zn, Stm, CHW)				1	1	
Hot/Cold Deck	2					
CHW	1					
Space	1					

Total of 6 Points with MUX at 8063

TABLE II-4 POINT LIST: (continued)

GYM W/POOL 8069

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
HW Pump-1				1	1	
HW Pump-2				1	1	
Pool Pump				1	1	
HV-1 (HW only)				1	1	
Discharge Air	1					
HV-2 (HW only)				1	1	
Discharge Air	1					
HV-3 (HW only)				1	1	
Discharge Air	1					
HV-4 (HW only)				1	1	
Discharge Air	1					
HV-5 (HW only)				1	1	
Discharge Air	1					
HV-6 (HW only)				1	1	
Discharge Air	1					
HV-7 (HW only)				1	1	
Discharge Air	1					
HV-8 (HW only)				1	1	
Discharge Air	1					
HV-9 (HW only)				1	1	
Discharge Air	1					
AH-1 (HW, DX)				1	1	
Discharge Air	1					
AH-2 (HW, DX)				1	1	
Discharge Air	1					
HW	1					
Space	3					

Total of 29 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

REG BDE HQ 8071

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
CHW Pump				1	1	
AHU-1 (10 Zn, Stm, CHW)				1	1	
Hot/Cold Deck	2					
CHW	1					
Space	1					

Total of 6 Points and 1 MUX

TABLE II-4 POINT LIST: (continued)

HEATING/COOLING CENTRAL PLANT 8073

ITEM	TEMP	PRESS	FLOW	CPA	TL	S/S	STAT	AL/C	OTHER
Oil HP-Stm Blr-1						1	1	1	
Oil HP-Stm Blr-2						1	1	1	
Boiler Water Level									2
Combustion Air	2		2						
Draft Pressure		4							
Blr Exh Gas	2								
Blr Exh Gas O_2%									2
Smoke Indicator									2
HP Steam	2	2	2						
FW Pump-1						1	1		
FW Pump-2						1	1		
FW Pump-3						1	1		
Feedwater	2	2	2						
Deaerator					1				
Fuel Oil Pump-1						1	1		
Fuel Oil Pump-2						1	1		
Fuel Oil	1	1	1		3				
Cond Pump-1						1	1		
Cond Pump-2						1	1		
Condensate	1				1				
Makeup Water	1		1						
Blr Water Conductivity									1
Absorp Chiller-1						1	1		
Absorp Chiller-2						1	1		
CHW Pump-1						1	1		
CHW Pump-2						1	1		
CDW Pump-1						1	1		
CDW Pump-2						1	1		
CHW	6		2						
CHW Supply CPA				2					
CDW	4		2						
Cooling Tower Fan-1						1	1		
Cooling Tower Fan-2						1	1		
Cooling Tower Fan-3						1	1		
Air Compressor		1				1	1		

Total of 78 Points and 6 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 8300

SIMILAR BUILDINGS 8320, 8340

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 8320

SIMILAR BUILDINGS 8300, 8340

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 8340

SIMILAR BUILDINGS 8300, 8320

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
Oil HW Boiler				1	1	1
HW Pump-1				1	1	
HW Pump-2				1	1	
BAY A						
UV-2A, E-1, E-4A, E-4B				1		
UH-XA, UH-XB, UH-XC, UH-XD				1		
Space	1					
HW	1					
BAY B						
UV-2B, E-2, E-4C, E-4D				1		
UH-XE, UH-XF, UH-XG, UH-XH				1		
Space	1					
BAY C						
UV-1A, UV-1B, E-3, E-4E, E-4F, E-4G, E-4H				1		
UH-YA, UH-YB, UH-ZA, UH-ZB				1		
UV-1C, E-4I, E-4J				1		
UH-YC, UH-YD, UH-YE, UH-YF				1		
Space	1					

Total of 16 Points and 2 MUX's

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 8360

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
MAH				1	1	
Discharge Air	1					
EF-3, 11, 15, 24				1		
HV-1				1	1	
Discharge Air	1					
HV-6				1	1	
Discharge Air	1					
VUH-1				1	1	
Eight VUH-2's				1		
Space	2					
EF-4, 5, 6, 12, 17, 18, 19				1		
Two CUH-1's						
WAC-5				1	1	
WAC-6				1	1	
AHU (MZ)				1	1	
Hot/Cold Deck	2					
ACC						
Space	1					
EF-1, 7, 8				1		
EF-13, 22				1		
HV-4				1	1	
Discharge Air	1					
HV-5				1	1	
Discharge Air	1					
Ten IRH's				1		
Two CUH-1's						
WAC-1				1	1	
WAC-2				1	1	
Space	3					
EF-16, 20, 21				1		
Three HUH-1's				1		
Three HUH-3's				1		
Two CUH-1's						
WAC-7				1	1	
WAC-8				1	1	
Space	1					

TABLE II-4 POINT LIST: (continued)

MOTOR REPAIR SHOP 8360 (continued)

ITEM	TEMP	PRESS	FLOW	S/S	STAT	AL/C
EF-2,9,10,14,23				1		
HV-2				1	1	
Discharge Air	1					
HV-3				1	1	
Discharge Air	1					
Twelve IRH's				1		
WAC-3				1	1	
WAC-4				1	1	
Space	3					

Total of 47 Points and 4 MUX's

For information on individual buildings, see Volumes 2 through 5 of this report. Point counts, cost and benefit estimates, and I/O Summary Tables are included in Volume 3.

C. BUILDINGS NOT RECOMMENDED FOR EMCS

1. Youth Center 71 has a program clock located in the manager's office. It is more economical to install a new program clock with battery backup power, than to tie into the EMCS.

2. Commissary 127 is a grocery store. Night setback is not practical, since the heating system does not have enough excess capacity for morning warm-up. Scheduling of air conditioning is not practical because of potential spoilage problems.

3. Residence Halls 144, 145, 146, 440, 441, 442, 480, 481, 5309: These buildings are occupied 24 hours per day, 7 days per week. Time-related programs such as scheduled start/stop and night setback are not feasible. Air conditioning is accomplished by window units; there is no practical method of switching these via the base-wide EMCS. For Will Hall 5309 (transient officers' quarters), where occupancy changes daily, a line-carrier energy management system may be worthwhile.

4. Aviation Operations Buildings 839 and 863 operate on a round-the-clock basis. Like other buildings which are always occupied, it is not practical to put these buildings on the EMCS.

5. Shoppette 5302 has a heat pump. Night setback and scheduling of air conditioning are not economical control schemes for heat pumps.

6. Telephone Exchange 6420 is a very small building. The expected energy savings is limited, and the cost of connecting to the EMCS cannot be justified. We recommend a program clock with battery backup and locking thermostats for this building.

For more information, see the first section in Volume 3 of this report.

D. CENTRAL PLANTS

1. CHILLER PLANT 7210

Chiller Plant 7210 serves thirteen barracks in the Custer Hill troop housing area. The plant includes two 504-ton and one

650-ton electric centrifugal chillers. The units all operate on 42 degrees F leaving water temperature. The two 504-ton units are piped in series, i.e., if the 650-ton unit is not operating, all chilled water flows through both units. The 650-ton unit is piped in parallel with the two 504-ton units.

The plant is operated from late May until late September each year, and at least one chiller runs, around the clock, during that time span. The plant operators manually start and stop a second chiller as they anticipate the need for additional cooling. To date there has been no need to run all three chillers simultaneously.

We are proposing 41 EMCS points for Building 7210. See Table II-5.

Under computer control there will be several energy saving oportunities:

a. Resetting chilled water temperature to meet the demand.

b. Resetting condenser water temperature for optimum chiller performance.

c. Optimum lead-lag operation of chillers.

d. Optimum start/stop.

e. Scheduled start/stop where the chillers will shut down at 2100 hours and restart at 0900 hours.

Table II-5
CHILLER PLANT 7210 COST SUMMARY
(February 1982)

Point	No. Pts.	Cost Each	Total
Chiller S/S w/Status	3	$1,150	$3,450
CHW Supply Temperature	4	870	3,480
CHW Return Temperature	4	880	3,520
CHW Flow	3	2,910	8,730
Entering CDW Temperature	3	870	3,480
Leaving CDW Temperature	3	870	3,480
CDW Flow	3	2,900	8,700
Chiller kWh	3	2,450	7,350
CHW Pump Status	3	650	1,950
CDW Pump Status	3	650	1,950
Cooling Tower Fan Status	6	650	3,900
CHW Temperature Adjust	3	1,360	4,080
Totals	41		$54,070

2. BOILER - CHILLER PLANT 8073

Building 8073 serves 28 buildings in the 8000 Area of Custer Hill. The plant contains two 14,700 MBH oil-fired steam boilers and two steam absorption chillers. The boilers generate steam at 125 psi and are fired by No. 2 fuel oil. The chillers supply 440 tons of cooling and 1,275 gpm of 42 degrees F chilled water each.

The plant is manned 24 hours per day year-round. The boilers supply the distribution loop with steam for heating and for

domestic hot water. The boilers also supply steam for the absorption machines during the cooling season. Consequently, at least one boiler is active at all times.

We are proposing 78 EMCS points for Building 8073. See Table II-6. These points will allow reassignment of operators currently stationed there. These points will also make it possible to save energy through:

a. Scheduled start/stop and optimum start/stop of the chillers.

b. Chiller optimization and chilled water temperature reset.

c. Boiler optimization.

All of these proposed control schemes have tentative approval of the chiller manufacturers.

Table II-6
BOILER-CHILLER PLANT 8073 COST SUMMARY
(February 1982)

Point	No. Req'd.	Cost Each	Total
Absorption Chiller S/S w/Status	2	$1,150	$ 2,300
CHW Supply Temperature	3	870	2,610
CHW Return Temperature	3	870	2,610
CHW Flow	2	2,900	5,800
CDW Flow	2	2,900	5,800
Entering CDW Temperature	2	870	1,740
Leaving CDW Temperature	2	870	1,740
CDW Pump S/S w/Status	2	650	1,300
CHW Pump S/S w/Status	2	650	1,300
Cooling Tower Fan S/S w/Status	3	650	1,950
CHW Supply CPA	2	1,340	2,720
Boiler S/S w/Status	2	1,150	2,300
Boiler Alarm Contactor	2	300	600
Boiler Water Level	2	2,700	5,400
Combustion Air Temp	2	800	1,600
Draft Pressure	4	800	3,200
Combustion Air Flowrate	2	800	1,600
Exhaust Gas Temperature	2	800	1,600
Exhaust Gas Oxygen Percent	2	800	1,600
Steam Pressure	2	800	1,600
Steam Temperature	2	800	1,600
Steam Flow Rate	2	800	1,600
Feedwater Temperature	2	800	1,600
Feedwater Pressure	2	800	1,600
Feedwater Flowrate	2	800	1,600
Smoke Indicator	2	1,100	2,200
Condensate Pump S/S w/Status	2	900	1,800
Condensate Tank Level	1	1,200	1,200
Condensate Temperature	1	800	800
Feedwater Pump S/S w/Status	3	1,150	3,450
Deaerator Tank Level	1	1,850	1,850
Makeup Water Temperature	1	800	800
Makeup Water Flowrate	1	2,000	2,000
Fuel Oil Tank Level	3	1,000	3,000
Fuel Oil Pump S/S w/Status	2	1,150	2,300
Fuel Oil Flowrate	1	1,900	1,900
Fuel Oil Temperature	1	800	800
Fuel Oil Pressure	1	1,350	1,350

Water Conductivity	1	2,300	2,300
Air Compressor S/S w/Status	1	1,150	1,150
Air Compressor Pressure Limits	1	800	800
Totals	78		$85,070

E. DATA TRANSMISSION MEDIA (DTM)

Ft. Riley is presently served by the United Telephone network and a government-owned network. Where spares are available, lines will be donated (by the government) or leased (from United Telephone). However, the availability of spare phone lines is limited and changes from day to day.

It will be helpful at this point to refer to Figure 1 at the end of Part I.

Data transmission for the EMCS will be via telephone lines equal to a 3002-C2 voice-grade circuit (conditioned). The existing telephone lines are unconditioned. Where existing telephone lines are used, conditioning equipment will be provided under the EMCS contract.

Communication between MUX panels and FID panels will be over two pairs of telephone lines provided under the EMCS contract. Table II-1 (page II-3) lists the costs for MUX-to-FID communication. The estimated cost for these lines is $209,890. Figure I indicates how

buildings are grouped together. One building in each group has a FID panel; the other buildings in the group will require new lines wired to the FID panel. Existing phone lines will link the FIDs to the CCU, through the central telephone exchanges.

The transmission system from Custer Hill to the Main Post area (Building No. 6420 to Building No. 33) will be over 16 pairs (i.e. two pairs for each Custer Hill FID, for backup protection) of telephone lines leased from United Telephone Company. The present lease rate is $1.50 per 1/4-mile per month per pair.

The transmission system between Main Post Central Exchange (Building No. 33) to the Central Computer System, located in Building No. 187, shall be over twenty-two (i.e. two pairs for each FID in the system, for backup assurance) pairs of telephone lines provided under the EMCS contract. The estimated cost of these lines is $50,000.

Subsequent upgrade projects may provide large numbers of available spares, and reduce the cost of the EMCS installation. For this report, we have assumed the present situation will not change, however.

F. DEMAND LIMITING

Demand limiting can be a highly effective method of reducing energy bills at Ft. Riley. The degree of success, however, is dependent on a firm commitment by post authorities to assign and keep an adequate number of low-priority users. Such users would consist primarily of cooling equipment in noncritical areas where a temporary shut-off of air conditioning would be acceptable.

Demand sensing equipment would be installed only at the Anzio Substation. This substation supplies most of the electrical power for Custer Hill and the Main Post or about 75 percent of the total Post consumption.

Demand limiting would be accomplished through the installation of a Pulse Accumulator and one MUX panel located at the substation. The demand pulse would be monitored and transmitted to the Central Computer System. As the demand approaches the Target Peak Demand, the System would begin shutting off low priority loads.

We have estimated a 3750-kW reduction in summer peak demand; this is equivalent to 15 percent of the 1980 peak. Such a reduction will produce a savings of about $100,000 annually.

Five other schemes for demand limiting by radio were considered. All five were found to be not feasible.

The alternatives were:

1. Switching of air conditioners for 860 units in the 1001 Family Housing group.

2. Switching of electric water heaters and air conditioners for 860 units in the 1001 Family Housing group.

3. Switching of electric water heaters and air conditioners for all units in the 1001 Family Housing group.

4. Switching of well pumps.

5. Switching of family housing and well pumps (i.e., combination of Alternatives 3 and 4).

See Volume 2, Section 2 for more details

G. MASTER CONTROL ROOM (MCR)

The EMCS computer room will be located in the basement of the Facilities Engineer building (Building No. 187). A remodel of an area adjacent to the boiler room will be necessary to accommodate the new electronic equipment. A cost breakdown and abbreviated description of the work are presented in Table II-7.

Table II-7
COSTS FOR MASTER CONTROL ROOM
(February 1982)

General Construction includes fire-rated partitions and door, cutting, patching, painting, telephones	$3,750
Mechanical includes air-conditioning units, humidity control, ductwork, diffusers	15,600
Electrical includes fluorescent light fixtures and power for computer equipment and air conditioning equipment	3,750
Furniture	5,000
Total	$28,100

A remote monitoring station will be required at the hospital boiler plant, building 486. If the new EMCS is compatible with the hospital EMCS, no new CRT or printer will be necessary. If spare phone lines are available the DTM cost could be as low as $1,000. Table II-8 illustrates the worst condition.

Table II-8
COSTS OF REMOTE MONITORING STATION
(February 1982)

B & W CRT	$9,600
Keyboard/printer	4,700
DTM	5,000
Subtotal	$19,300

Note: If new EMCS is compatible with existing hospital EMCS, cost for remote station could be as low as $1,000.

H. OPERATIONS AND MAINTENANCE COSTS

The EMCS concept is relatively new and has been marked by rapid advancements. Because this technology has such a short history and nearly every installation is a new prototype, predicting O&M costs has been very difficult. This firm's investigation consisted of searches through periodicals, manufacturers' recommendations, conversations with designers, operators and managers of EMC systems. No one source agreed closely with any other.

The following is our best estimate of annual costs:

1. Maintenance cost, for the first year, is approximately $60 per point. For the Ft. Riley EMCS, that amounts to $60 x 2,314 points = $138,840. (In other words, this would permit

approximately 8 hours of maintenance at $50 per hour for each of 347 points (15 percent of total) the first year.)

2. Maintenance cost, for subsequent years, is approximately $150 per point. For the proposed system, that amounts to $150 x 2,314 points = $347,100 per year. (This rate would allow 3 plus servicemen per year full time plus parts and equipment billed at "service" rates.)

3. Operations costs are primarily additional labor attributable to the EMCS operators.

Additional power use, supplies, furniture and the like are negligible costs in comparison to the additional labor. Ft. Riley estimates one new WG11 operator will be required. The cost of this man will be $20,800 per year, plus benefits: $20,800 x 130 percent benefits = $27,040 per year.

The EMCS will be monitored around the clock by operators trained and certified by the equipment manufacturer. In addition to checking the routine functions of the EMCS, the operator must be capable of responding quickly to user requests and alarms.

The ratio of O&M cost to the EMCS cost is 13.6 percent. See Volume 2, page 7-5.

If the EMCS function is extended to include fire protection and security, the operators must be trained in those areas, too.

I. CONDITION OF EXISTING CONTROLS

The Ft. Riley maintenance force is unique because it includes a controls shop with an adequate stock of replacement parts, a trouble-shooting lab and well-trained personnel.

In general, the survey teams found the existing controls to be in satisfactory condition. However, their inspection was limited. For example, some problems, such as economizer controls out of calibration, can only be detected by testing, and that treatment was beyond the scope of the field work. Many more problems with the old controls will become evident when the EMCS work commences. Therefore, we are recommending a lump sum of $50,000 for repairing existing controls which do not work properly or are incompatible with the EMCS.

Table II-9 lists modifications and corrections which we are aware of. These costs have been accounted for in the economic analysis.

Table II-9
MODIFICATIONS AND CORRECTIONS TO EXISTING CONTROLS

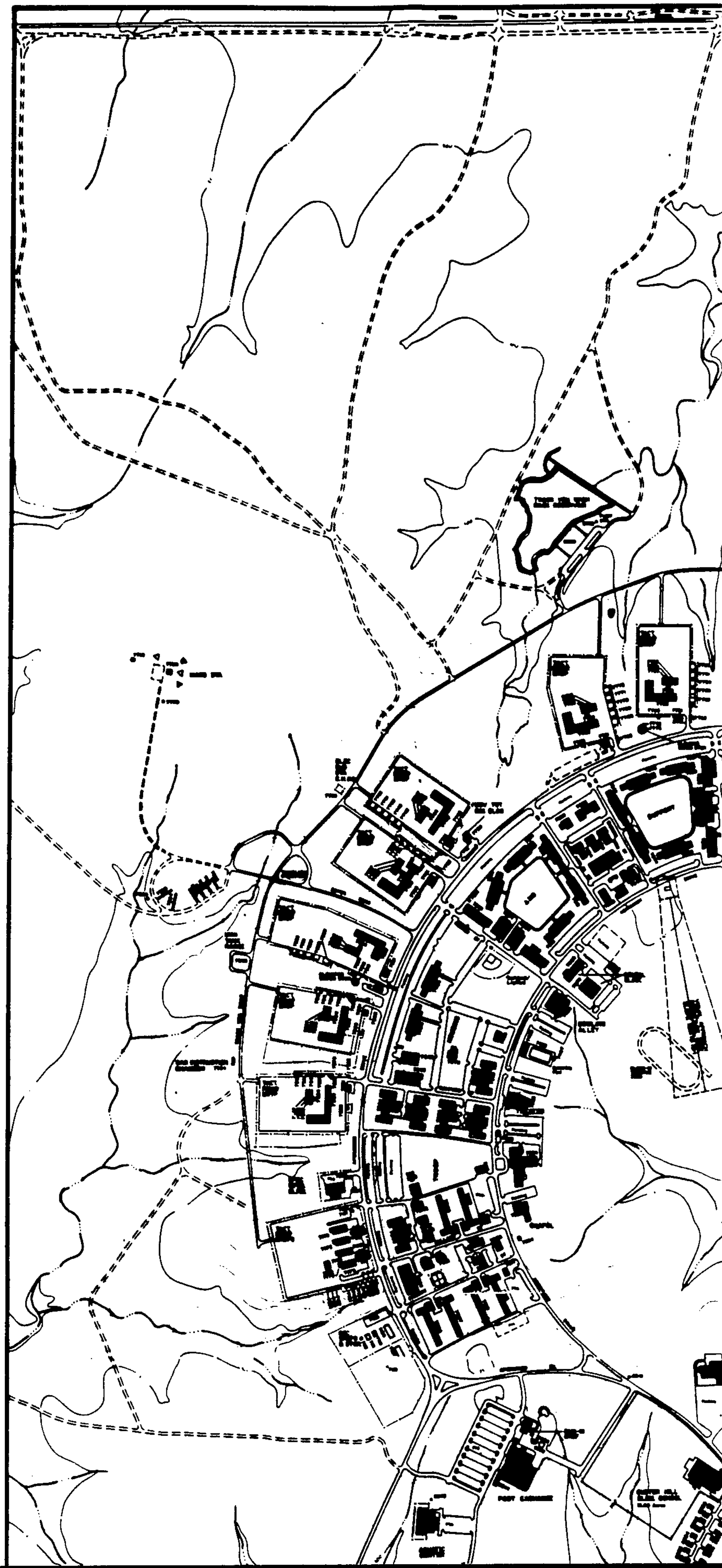
Bldg. No.	Bldg. Function	Action	Cost (February 1982)
34	Administration	Replace broken belt on air handler HV-1	Note 1
72	Band Training	Fix night setback control	Note 1
149	Barracks	Modify steam pipe and controls for night setback	$2,000
165	Barracks	Modify steam pipe and controls for night setback	$2,000
6620	NCO Club	Modify piping and controls for CHW and CDW reset	$2,000
6940	Pool	Add humidistat for AH-2	$ 600
7024	Gymnasium	Overhaul controls and damper seals	$2,000
7033	Administration	Provide starter for HW pump	Note 1
7044	Barracks W/Mess	Modify steam piping and controls for night setback	$2,000
7048	HQ	Fix 3-way valve at boiler	Note 1
7227	Barracks W/Mess	Fix AHU-1 econommizer. Modify steam piping and controls for night setback.	Note 1 $2,000
7305	Special Weapons Classroom	Overhaul controls	Note 2
7230	Barracks W/Mess	Modify steam piping and controls for night setback.	$2,000
7233	Barracks W/Mess	Modify steam piping and controls for night setback.	$2,000
7253	Adj. General	Modify steam piping and controls for night setback	$2,000

Table II-9 (continued)
MODIFICATIONS AND CORRECTIONS TO EXISTING CONTROLS

Bldg. No.	Bldg. Function	Action	Cost (February 1982)
7720	Motor Repair Shop	Tighten damper linkage, provide filters, close access doors for two UV-2's.	Note 1
7740	Motor Repair Shop	Tighten damper linkage, provide filters, close access doors for two UV-2's.	Note 1
7854	Mess Hall	Cover torch-cut panels in AHU-1 and 2.	Note 1

Notes:
1. This is within routine duties of base maintenance force; it is assumed they will take action.
2. Maintenance has scheduled this for autumn 1981.

APPENDIX A – EXHIBIT 1



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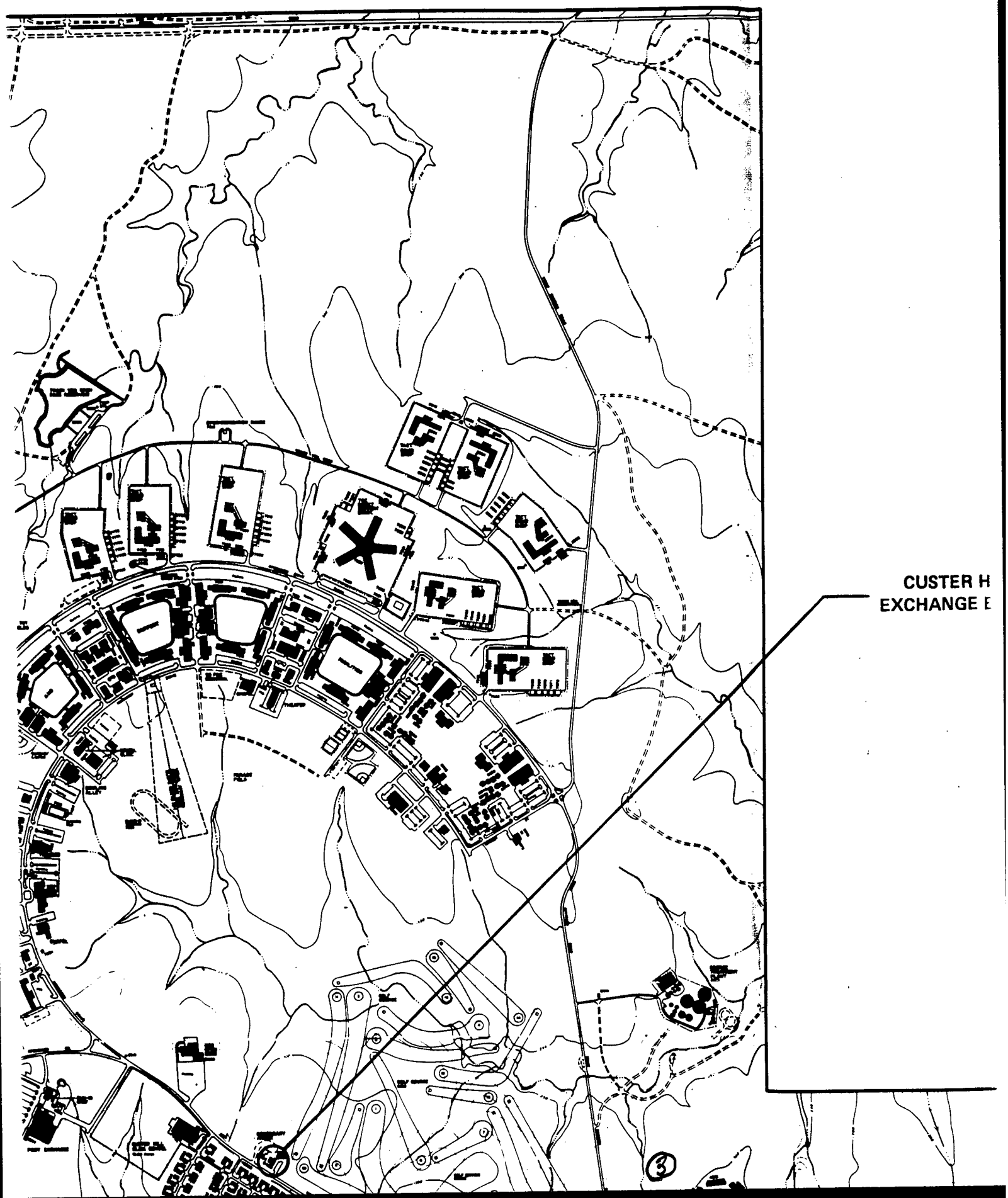
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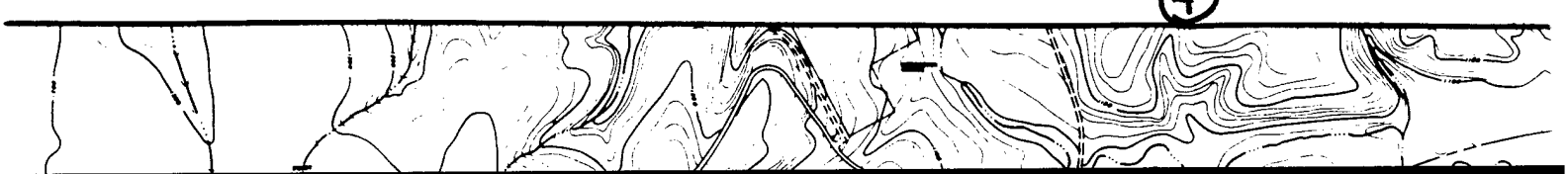
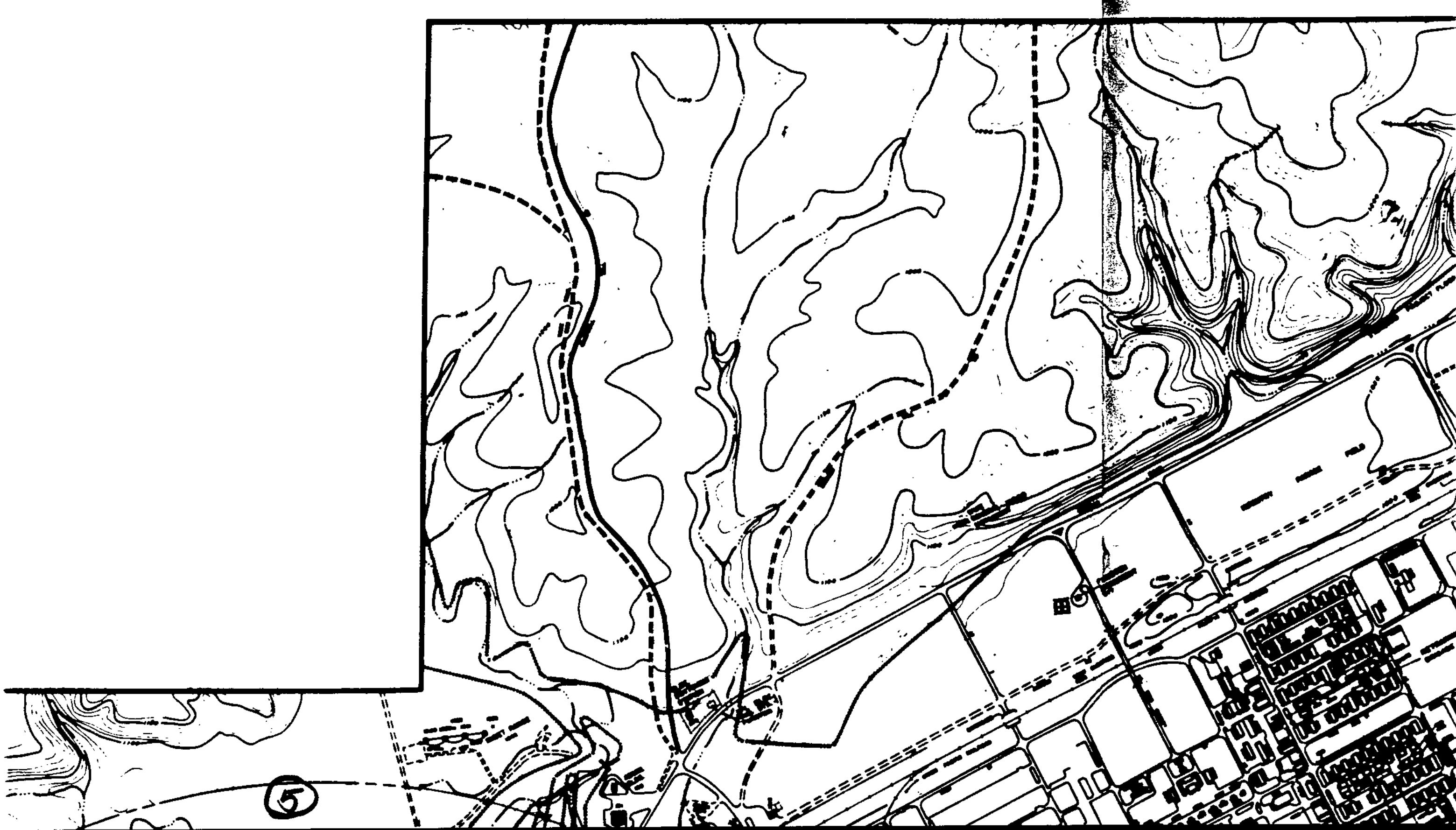
EXCHANGE E

CUSTER HILL TELEPHONE
EXCHANGE BUILDING NO. 6420

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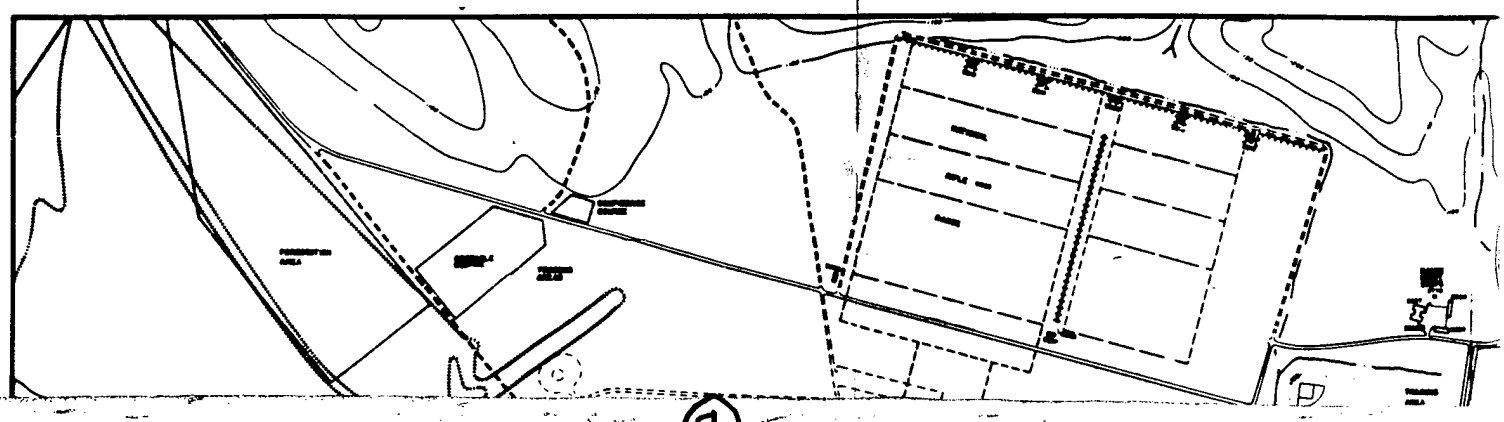

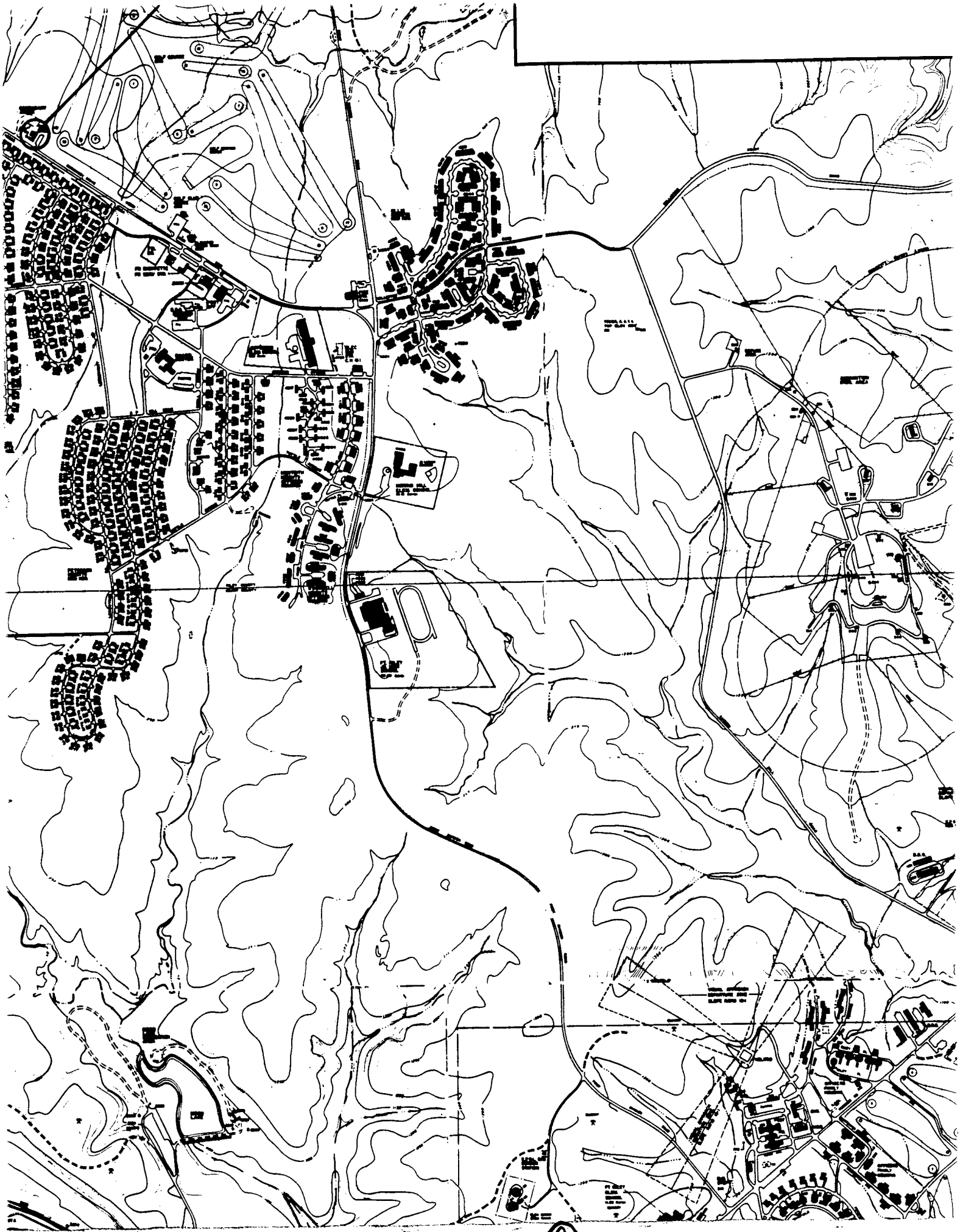

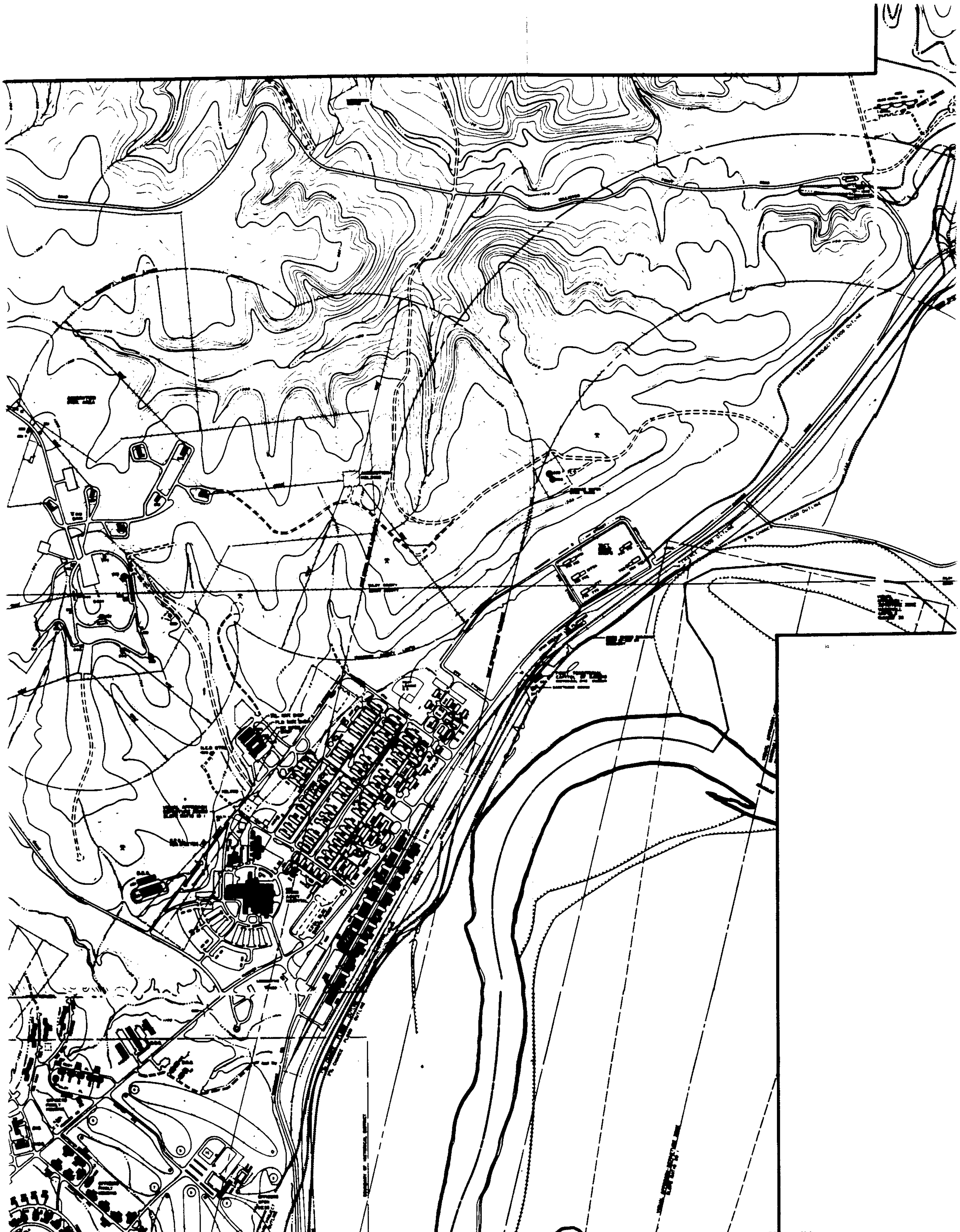

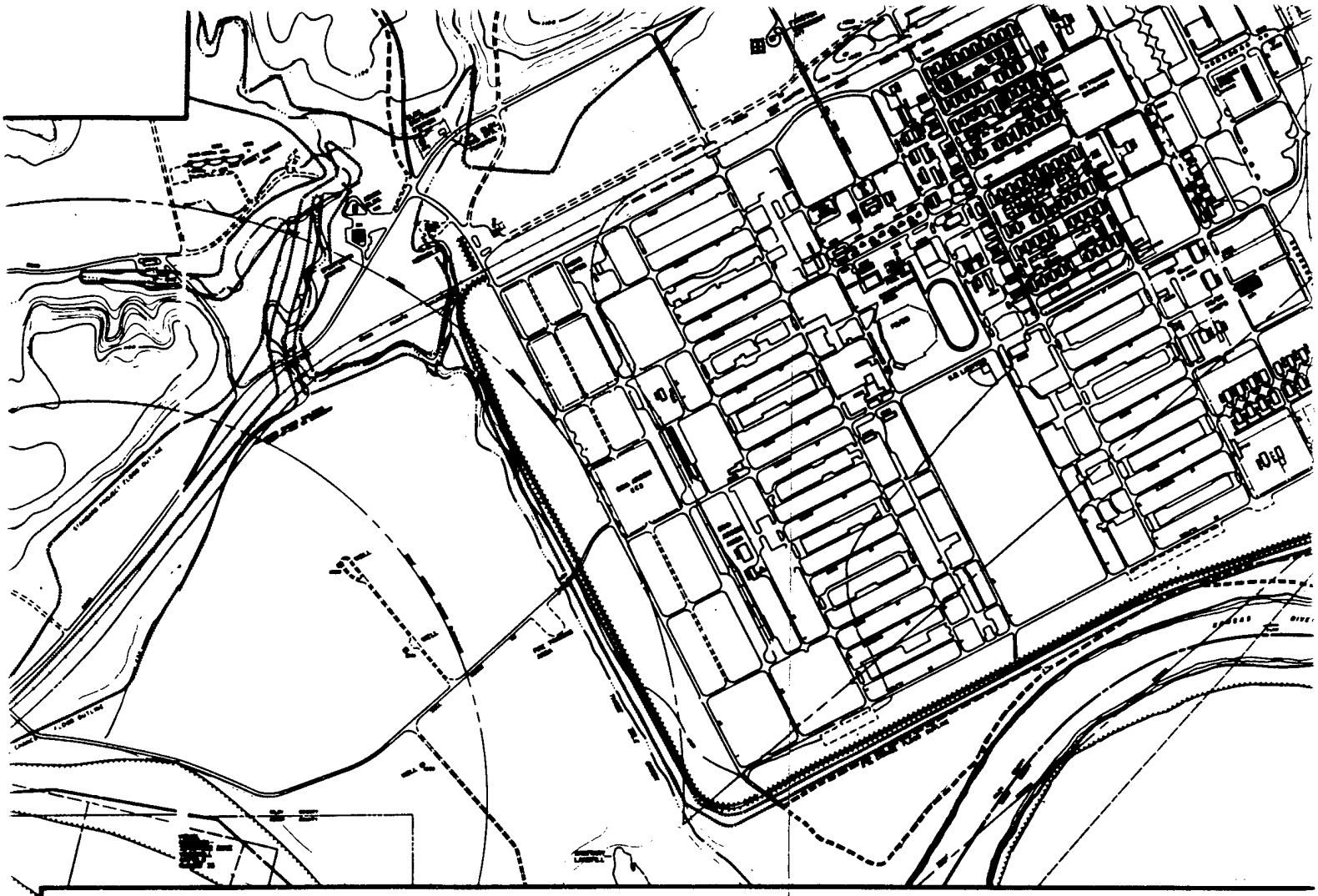

LEGEND

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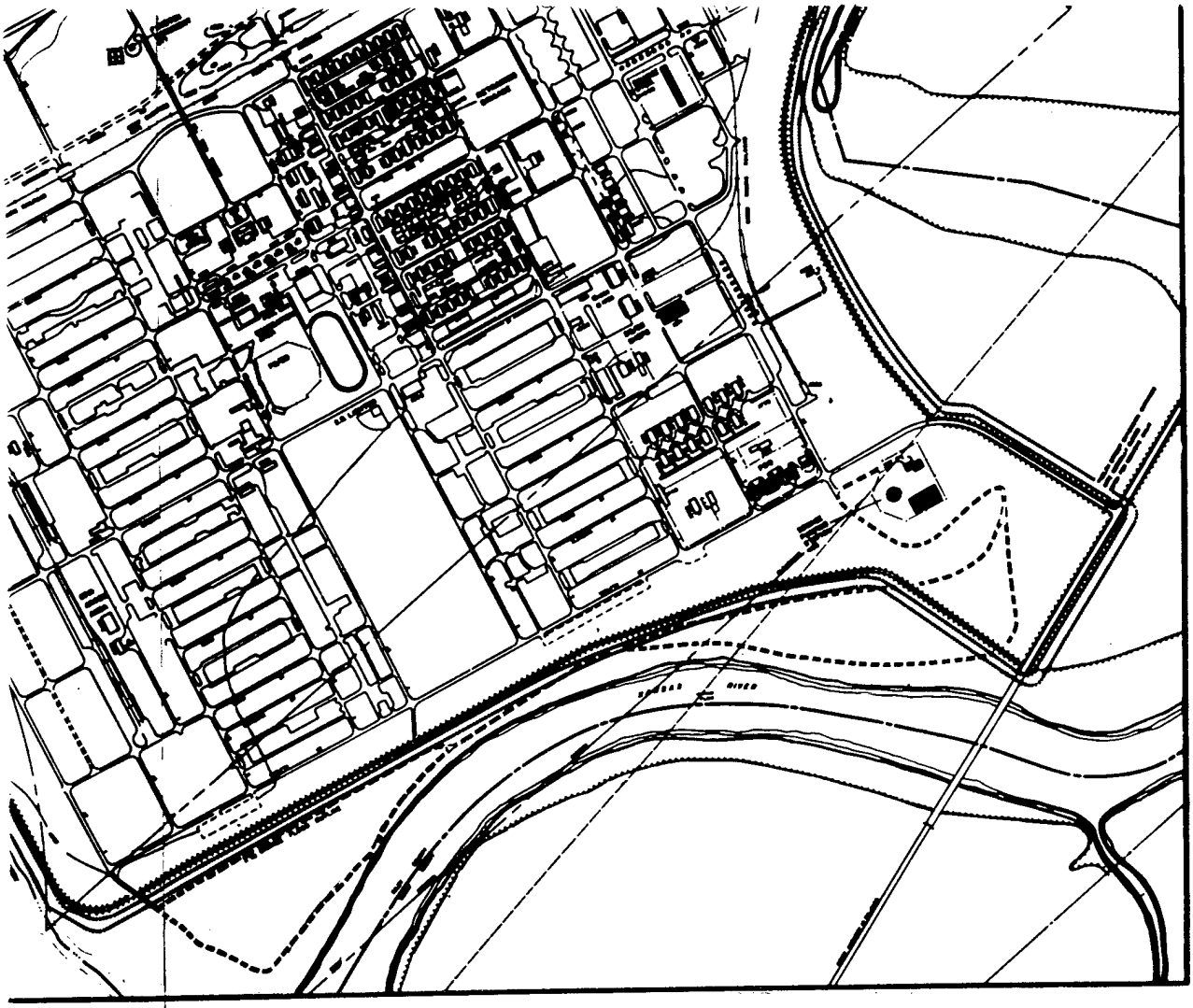
- BUILDING, SEMI-PERMANENT
- BUILDING, TEMPORARY
- PAVEMENTS
- ROADS, UNIMPROVED
- RAILROAD
- FENCE
- AREA OUTLINE
- RESERVATION BOUNDARY
- RIGHT-OF-WAY OR EASEMENT
- BRIDGE
- CULVERT
- DRAINAGE CHANNEL
- DAM
- SHORELINE
- LEVEE
- CENTERLINE
- BENCH MARK
- DEPRESSION
- TOP OF STEEP SLOPE
- INDEX CONTOUR — 1700
- INTERMEDIATE CONTOUR



LEGEND

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- PAVEMENTS
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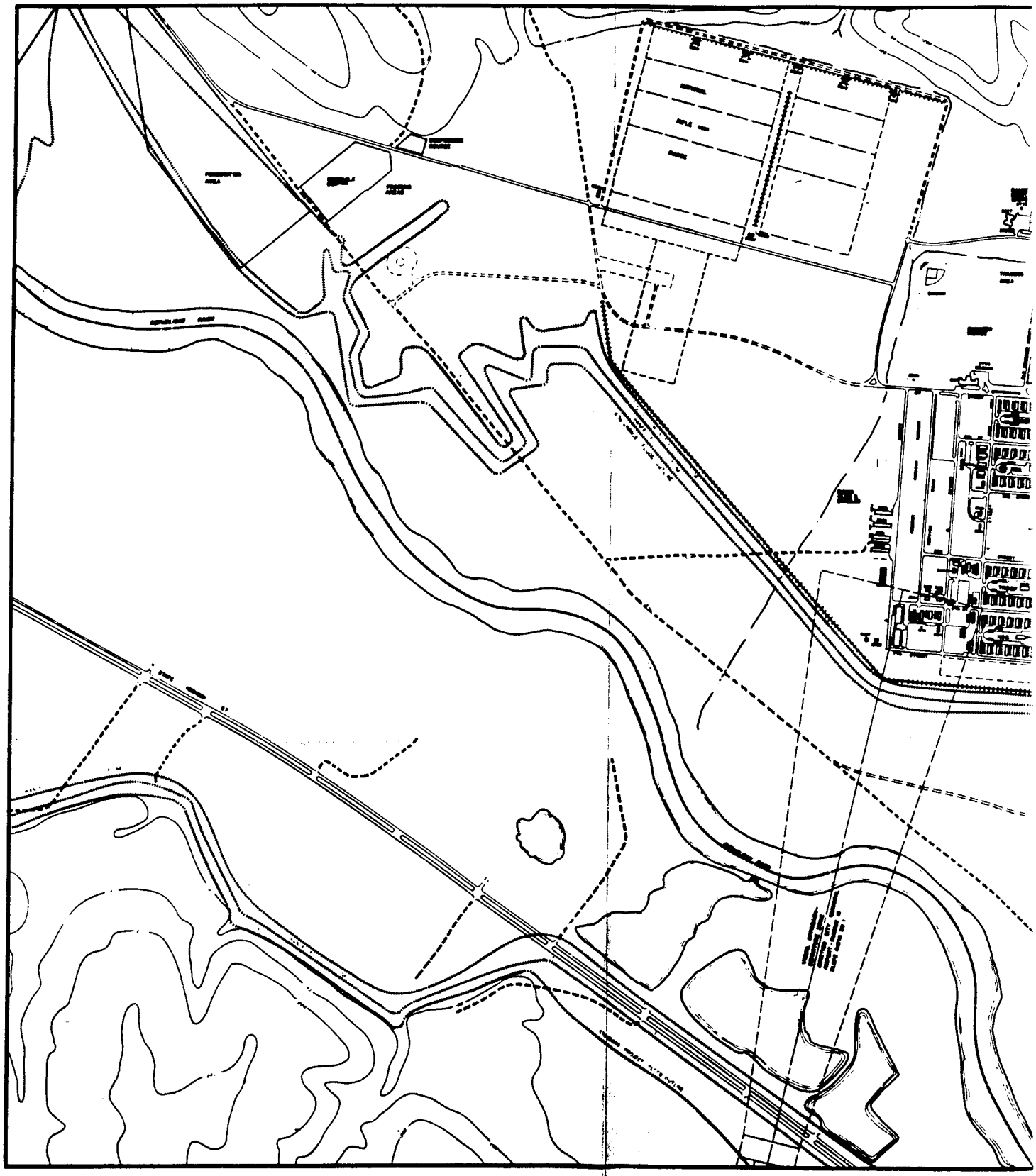

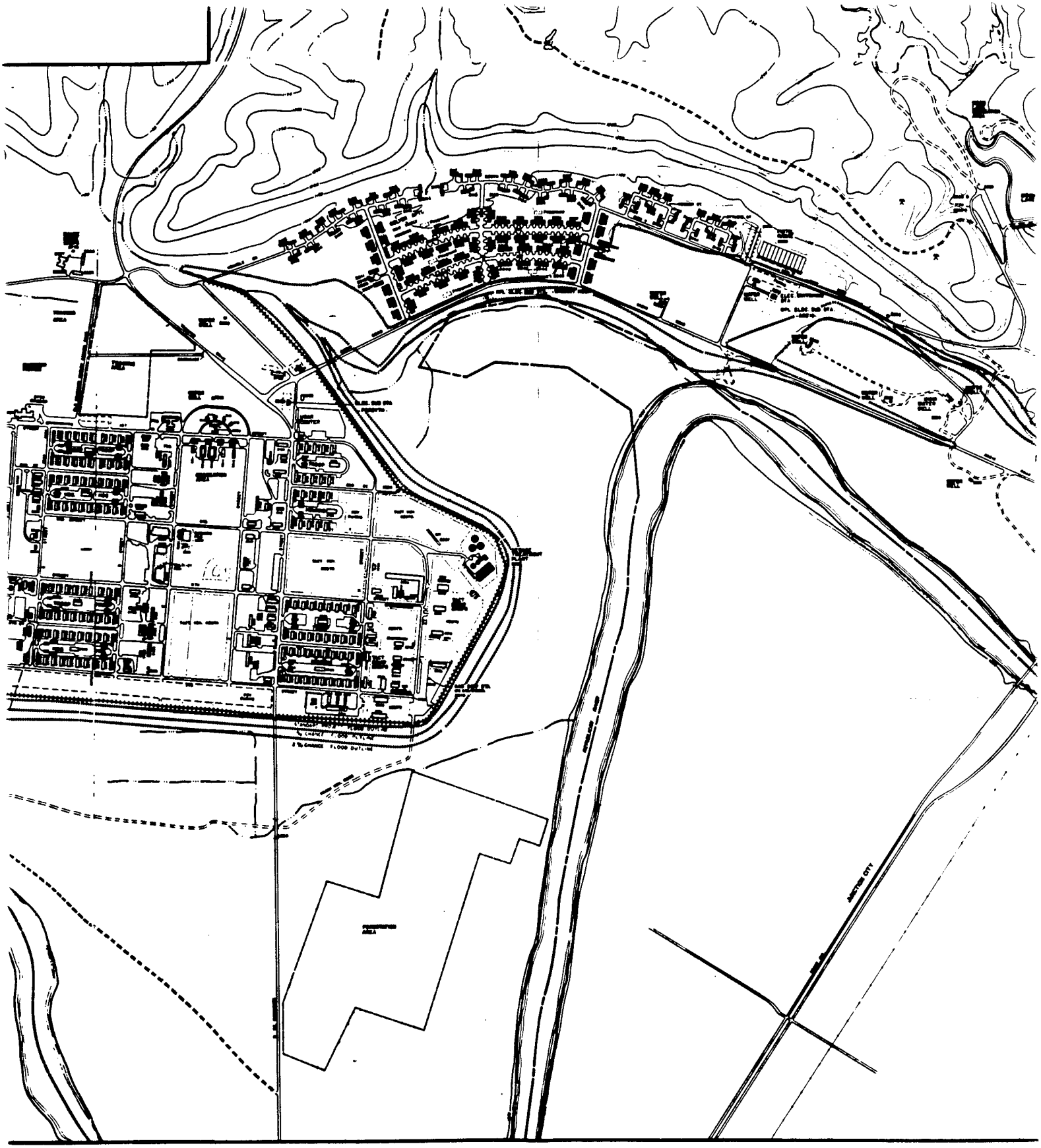

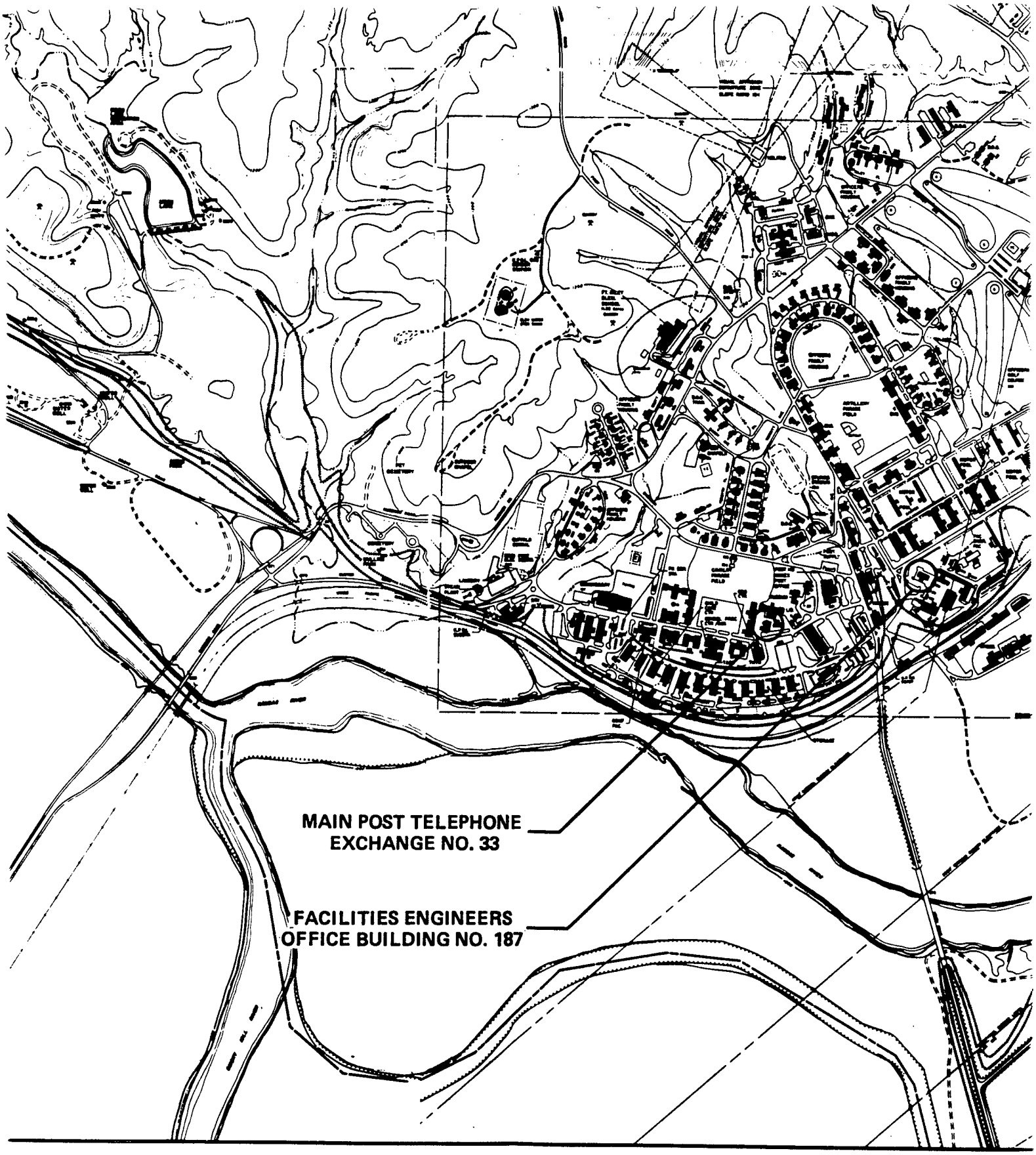
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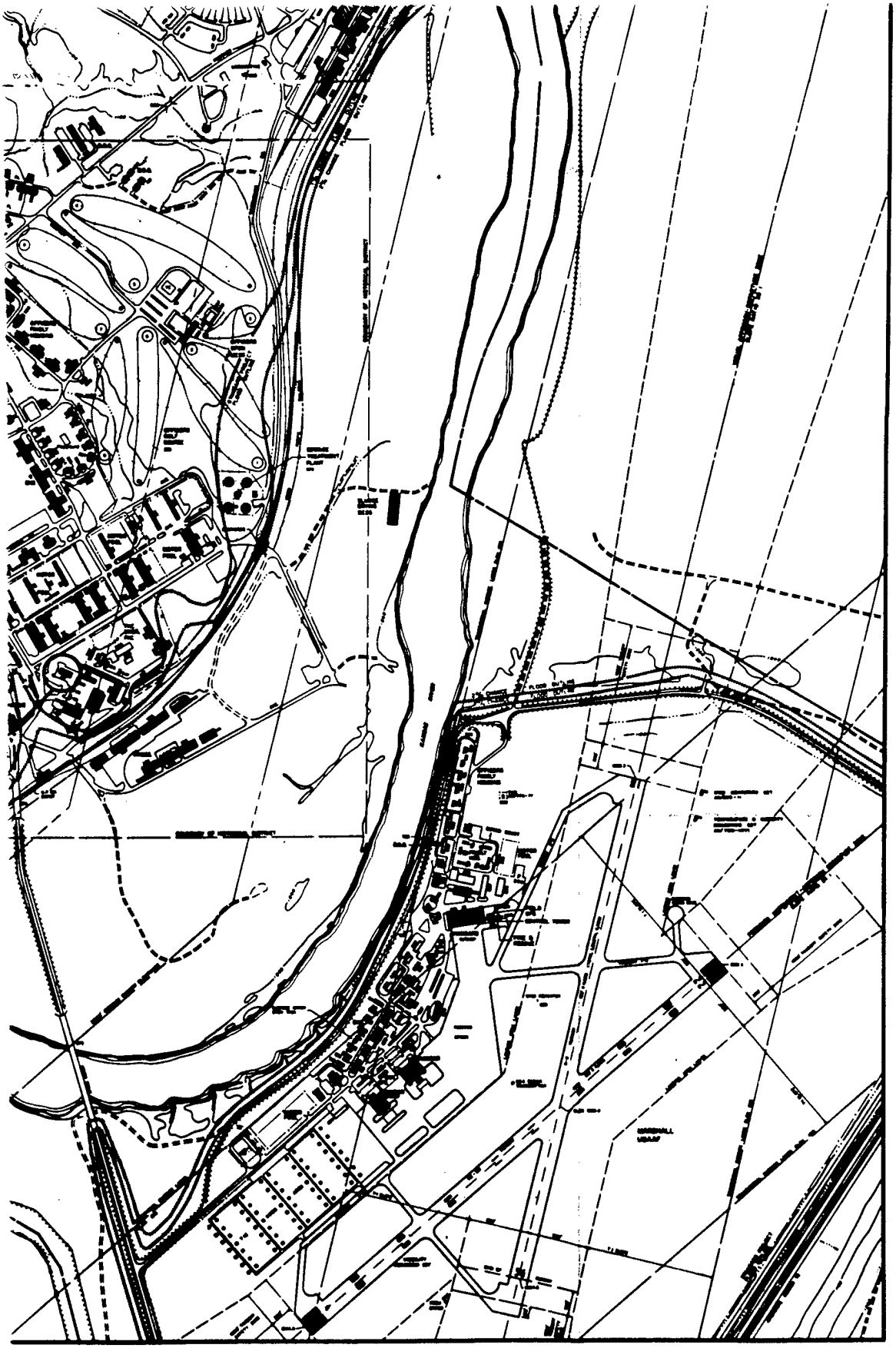
EXCHANGE NO. 33
FACILITIES ENGINEERS
OFFICE BUILDING NO. 187



RESERVATION BOUNDARY

RIGHT-OF-WAY OR EASEMENT

BRIDGE

CULVERT

DRAINAGE CHANNEL

DAM

SHORELINE

LEVEE

CENTERLINE

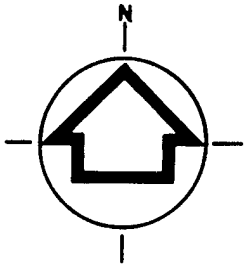
BENCH MARK

DEPRESSION

TOP OF STEEP SLOPE

INDEX CONTOUR 1700

INTERMEDIATE CONTOUR



SCALE IN FEET

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SCALE IN METERS

FORT RILEY

KANSAS

HIGGINBOTHAM AND ASSOCIATES
ARCHITECTS AND PLANNERS
COLORADO SPRINGS, COLORADO 80903

U.S. ARMY ENG
COR
KANSAS

Exhibit 1

ENERGY MONITORING AND CONTROL S

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

Robert E. Sp

ROBERT E. SPILLER, C
DEPUTY POST COMM
CHAIRMAN INSTALLAT

DATE 1 MAR. 1977

REVIEWED & COMMENTED ON BY MAJOR COMMANDER
& FORWARDED TO THE CHIEF OF ENGINEERS

DATE

RIGHT-OF-WAY OR EASEMENT

BRIDGE

CULVERT

DRAINAGE CHANNEL

DAM

SHORELINE

LEVEE

CENTERLINE

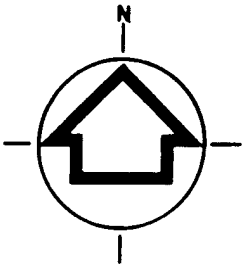
BENCH MARK

DEPRESSION

TOP OF STEEP SLOPE

INDEX CONTOUR 1700

INTERMEDIATE CONTOUR



SCALE IN FEET

1200 600 0 1200 2400 3600

300 150 0 300 600 900 1200

SCALE IN METERS

FORT RILEY

KANSAS

HIGGINBOTHAM AND ASSOCIATES ARCHITECTS AND PLANNERS COLORADO SPRINGS, COLORADO 80903	U.S. ARMY ENGINEER DISTRICT, KANSAS CITY CORPS OF ENGINEERS KANSAS CITY, MISSOURI 64106

Exhibit 1

ENERGY MONITORING AND CONTROL SYSTEM

IDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

Robert E. Spiller

ROBERT E. SPILLER, COL, INF.
DEPUTY POST COMMANDER
CHAIRMAN INSTALLATION PLANNING BOARD

AR. 1977

& COMMENTED ON BY MAJOR COMMANDER
IDED TO THE CHIEF OF ENGINEERS

DATE 1 MAR, 1977	DRAWING NO. 18-02-06
SHEET NO. 11 OF 94	AREA NO.

APPENDIX B – ENERGY POINTS

APPENDIX B

ENERGY POINTS

Not all EMCS points are intended to save energy. Some points serve other useful purposes, such as maintenance management or safety.

This fact creates a problem in approving funds for energy management systems, since energy-related projects are judged by ECIP criteria (E/C ratio, B/C ratio, payback)[1].

To officially recognize the need for points which do not meet ECIP criteria, the Corps of Engineers group in Huntsville has made these policy statements:

1. Each EMCS point does not need to meet E/C and B/C minimums. However, the overall EMCS project still must meet all ECIP criteria.
2. Maintenance points are not to be counted in calculating E/C ratios; only energy points are to be included.
3. Maintenance points must be accounted for in calculating B/C ratios and payback periods.

[1] See Reference 3 for a full explanation of these terms.

And so, the distinction between energy points and maintenance points is very important. Here are our definitions:

Energy points are EMCS points which directly or indirectly save enough energy to pay for themselves.

Maintenance points do not save enough energy to pay for themselves.

Some maintenance points pay for themselves in labor savings. For instance, automating a boiler plant frees the operators to meet other needs by the workforce.

Some maintenance points also save energy, even though it is not enough to fully pay for themselves. For example, some start/stop points on fans will not pay for themselves; such points are included to improve surveillance. But, such points will make duty cycling possible; and some limited savings will result.

Maintenance points are inexpensive. They can be added for half the cost of energy points. This is because most MUX, FID, wiring and central computer costs are borne by energy points.

Maintenance points contribute to workforce productivity to a much larger degree than energy points. Maintenance points can reduce checkup visits to mechanical rooms, because critical equipment items can be monitored automatically.

Adding maintenaance points adds protection against damage due to freeze-ups and forgotton maintenance. The Ft. Riley Facilities Engineer anticipates a reduction of $27,000 per year in avoided damage (this is not included in the economic analysis).

Table B-1
ENERGY POINTS - IMPORTANT FACTS

Project Cost	$2,771,100
B/C Ratio	4.0
E/C Ratio	41
Payback Period	2.9 yrs
Number of Points	939
Number of Buildings Controlled	178

Table B-2
COST SUMMARY FOR ENERGY POINTS
(Feb 82)

1.a.	Central Computer Equipment[1]	$ 426,900	
b.	FID's[2]	115,500	
c.	MCR[3]	28,100	
d.	Remote Monitor[4]	$ 19,300	
	Subtotal 1	$ 589,800	$ 589,800
2.a.	Field Hardware[5]	$1,378,940	
b.	Modifications to Existing Controls[5]	20,600	
c.	DTM[6]	259,020	
	Subtotal 2	$1,658,560	$1,658,560
3.a.	Training[7]	$12,500	
b.	Documentation[8]	98,440	
	Subtotal 3	$ 110,940	$ 110,940
4.	Allowance for Control Work		$ 50,000
5.	Contingencies[9]		$ 229,840
6.	Supervision and Administration[10]		$ 131,960
	Total Project Cost		$2,771,100

Notes: Items 1,2,3,4 Include Contractor's Overhead and Profit.
[1]See Table B-4.
[2]7 FIDs x $16,500 each.
[3]See Table II-7 (page II-137).
[4]See Table II-8 (page II-138).
[5]See Table B-6 (pages B-8 through B-16).
[6]See Table B-6 and pages II-33 & 34:
[7]$209,020 + $50,000 = $259,020
[8]Per Manufacturer's Estimate
[9]5% x [1+2a.].
[10]10% x [1+2+4].
5% x [1+2+3+4+5].

Table B-3
ECONOMIC ANALYSIS SUMMARY FOR ENERGY POINTS (July 1986 Dollars)

Economic Life: 15 Years

Cost			
1. Nonrecurring Initial Capital Costs			
a. CWE[1]		$3,568,330	
b. Design (5% of 1a)		178,420	
c. Salvage Value of Existing System		Negligible	
d. Total			$3,746,750
Benefits			
2. Recurring Benefit/Cost Differential Other than Energy			
a. Annual Labor Decrease (+)/Increase (-)[2]		$-34,820	
b. Annual Maintenance Decrease (+)/Increase (-)[3]		$-181,370	
c. DTM Rental Decrease (+)/Increase (-)		$ -2,410	
d. Total Costs		$-218,600	
e. 10% Discount Factor		7.980	
f. Discounted Recurring Cost (dxe)			$-1,744,430
3. Recurring Energy Benefit/Costs			
a. Electricity			
(1) Annual Energy Decrease		53,861/Mega Btu	
(2) Cost per Mega Btu		$8.17/Mega Btu	
(3) Annual Dollar Decrease		$440,044/yr	
(4) Differential Escalation Rate (7%) Factor		10.57	
(5) Discounted Dollar Decrease		$4,651,269	
b. Natural Gas			
(1) Annual Energy Decrease		68,958/Mega Btu	
(2) Cost per Mega Btu		$6.68/Mega Btu	
(3) Annual Dollar Decrease		$460,639/yr	
(4) Differential Escalation Rate (8%) Factor		13.55	
(5) Discounted Dollar Decrease		$6,241,664	
c. No. 2 Fuel Oil			
(1) Annual Energy Decrease		24,717/Mega Btu	
(2) Cost per Mega Btu		$14.91/Mega Btu	
(3) Annual Dollar Decrease		$368,530/yr	
(4) Differential Escalation Rate (8%) Factor		11.41	
(5) Discounted Dollar Decrease		$4,204,933	
d. Electrical Demand Reduction			
(1) Reduction in summer peak		3,750kW	
(2) Annual Dollar Decrease		$162,676/yr	
(3) Differential Escalation Rate (7%) Factor		10.57	
(4) Discounted Dollar Decrease		$1,719,485	
e. Discounted Energy Benefits [3a(5)+3b(5)+3c(5)+3d(4)]			$16,817,351
4. Total Benefits (sum 2f+3e)			$15,072,921
5. Discounted Benefit/Cost Ratio (Line 4 ÷ Line 1d)			4.0
6. Total Annual Energy Savings [3a(1)+3b(1)+3c(1)]			147,536 Mega Btu
7. E/C Ratio (Line 6 ÷ Line 1a/1000)			41
8. Annual $ Savings [2d+3a(3)+3b(3)+3c(3)+3d(2)]			$1,213,289
9. Pay-back Period [(Line 1a-Salvage) ÷ Line 8]			2.9 yrs

Table B-3

ECONOMIC ANALYSIS SUMMARY FOR ENERGY POINTS (July 1986 Dollars) (continued)

Notes:

1 $\text{Escalation} = \frac{\text{July 86}}{\text{Feb 82}} = \frac{1,580}{1,227} = 1.288$

$2,771,100 x escalation = $3,568,330

2 $27,040 x escalation = $34,820

3 $150/pt. x 939 pts. x escalation = $181,370

4 $19.50/mo-pr x 8 pr x 12 mo/yr x escalation = $2,410

Table B-4
CENTRAL COMPUTER EQUIPMENT
FOR TRI-SERVICES MEDIUM EMCS
(Feb 82)

Item	Cost
CPU	$ 70,900
Color CRT	10,100
B&W CRT	9,600
Alarm Printer	4,700
Disk Drive	32,200
Floppy Disk	8,600
Calendar Clock	3,800
Software	121,000
Test Equipment	32,000
Contractors OH&P	134,000
Total	$426,900

Table B-5
ESTIMATED UNIT PRICES FOR FIELD HARDWARE
(Feb 82)

Item	Cost
FID	$16,500
MUX	1,890
Air Temperature Point	800
Water Temperature Point (Note 2)	850
Pressure or Humidity Point	1,350
Damper Position Indicator Point	1,200
Alarm Contract Point	650
Binary Temperature Point	650
Start/Stop Point w/Status	1,150
Start/Stop Point w/o Status	1,000
Status Only	650
Control Point Adjustment (CPA)	1,360
Accumulator (kW input)	2,450
Accumulator (demandd meter contact)	780
Analog Flow (Note 2)	2,700

Notes
1. Estimates include labor, material, on-post travel time allowance, wiring allowance (100 ft/point).
2. Estimate includes allowance for installation of sensor well in piping.

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
3	Chapel	3840	–	2000	5840	65	103	–	168	2	19
32	Field House	10,490	–	870	11,360	38	1670	–	1708	8	67
34	Admin.	5640	–	870	6510	59	1064	–	1123	4	73
37	Admin.	14,890	–	870	15,760	568	950	–	1518	12	50
40	Barracks	7190	–	870	8060	863	599	–	1462	5	75
46	Child Care	4090	–	870	4960	465	272	–	737	2	67
70	Finance	5790	–	870	6660	11	541	–	552	4	45
72	Band Training	3840	–	870	4710	–	155	–	155	2	21
75	Red Cross	3840	–	870	4710	10	139	–	149	2	20
89	Barracks	4090	–	870	4960	406	113	–	519	2	53
90	Barracks	4090	–	870	4960	491	56	–	547	2	55
91	Barracks	4090	–	870	4960	406	113	–	519	2	53
92	HQ	3690	–	870	4560	–	266	–	266	2	34
93	Barracks	4090	–	870	4960	406	113	–	519	2	53
94	Barracks w/Mess	9690	–	870	10,560	1797	–	80	1877	8	74
108	Post HQ	4090	–	2000	6090	–	1073	–	1073	2	75
126	Warehouse	5790	–	870	6660	139	545	–	684	4	52
128	Chapel	3840	–	2000	5840	65	103	–	168	2	19
149	Barracks	8590	2000	870	11,460	426	169	–	595	5	31
163	Theater	5790	–	870	6660	865	303	–	1168	4	74
165	Barracks	8590	2000	870	11,460	426	169	–	595	5	31
184	Rec. Ctr.	7840	–	870	8710	255	366	–	621	4	40
201	Admin.	6290	–	870	7160	–	3397	–	3397	5	118
205	Motor Rep. Shop	4090	–	870	4960	–	854	–	854	2	73
255	Officer's Club	13,840	–	3530	17,370	830	374	–	1204	12	39

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
296	Marksmanship	4090	–	3620	7710	–	319	–	319	2	26
315	Barracks w/Mess	4090	–	2000	6090	360	48	–	408	2	38
355	HQ	3840	–	870	4710	–	139	–	139	2	19
487	BOQ	5090	–	870	5960	450	–	–	450	3	41
801	Admin.	6490	–	870	7360	372	920	–	1292	5	74
860	Flight Training	4090	–	870	4960	109	156	–	265	2	32
864	Hangar	5240	–	870	6110	32	1646	–	1678	3	94
866	Hangar	5240	–	870	6110	32	1646	–	1678	3	94
1470	Army Reserves	5390	–	4100	9490	–	–	377	377	3	25
1950	Salvage	6790	–	4100	10,890	74	–	762	836	5	42
1980	Field House	9890	–	4100	13,990	7	1052	–	1059	7	42
5302	Post Office	4990	–	4900	9890	236	271	–	507	3	31
5315	Chapel	9240	–	4900	14,140	463	392	–	855	7	35
6620	NCO Club	16,410	2000	870	19,280	598	285	–	883	14	28
6910	Run-in Chef	16,850	–	870	17,720	1257	–	–	1257	14	39
6914	Main Px										
6940	Pool	3840	600	870	5310	183	–	377	560	2	53
7004	Barracks w/Mess	6140	–	870	7010	346	84	–	430	4	35
7007	Barracks w/Mess	6140	–	870	7010	346	84	–	430	4	35
7010	Barracks w/Mess	6140	–	870	7010	346	84	–	430	4	35
7013	Barracks w/Mess	6140	–	870	7010	346	84	–	430	4	35
7017	HQ	3840	–	870	4710	–	110	–	110	2	15
7024	Gym	2200	2000	870	5070	211	1381	–	1592	2	101
7028	EM Club	4840	–	870	5710	47	144	–	191	3	21
7031	Classroom	1950	–	870	2820	–	157	–	157	2	32

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7033	Dispensary	1950	–	870	2820	113	162	–	275	2	50
7034	Dispensary	3840	–	870	4710	113	162	–	275	2	34
7036	HQ	1950	–	870	2820	111	418	–	529	2	77
7044	Barracks w/Mess	5390	2000	870	8260	359	110	–	469	3	33
7046	Classroom	1950	–	870	2820	–	157	–	157	2	32
7047	Classroom	3840	–	870	4710	–	157	–	157	2	21
7048	HQ	1950	–	870	2820	–	110	–	110	2	24
7050	Barracks w/Mess	6140	–	870	7010	346	84	–	430	4	35
7053	Barracks w/Mess	6140	–	870	7010	346	84	–	430	4	35
7055	HQ	3840	–	870	4710	–	110	–	110	2	15
7086	Chapel	6040	–	870	6910	176	259	–	435	4	36
7210	Chiller Plant	59,740	–	870	60,610	3969	–	–	3969	41	37
7215	HQ	3840	–	870	4710	–	110	–	110	2	15
7224	Barracks w/Mess	3500	2000	870	6370	359	110	–	469	3	41
7227	Barracks w/Mess	5390	2000	870	8260	359	110	–	469	3	33
7230	Barracks w/Mess	6390	2000	870	9260	469	207	–	676	4	41
7233	Barracks w/Mess	6390	2000	870	9260	469	207	–	676	4	41
7243	Five Co. Admin. & Stor.	1950	–	870	2820	6	470	–	476	2	72
7245	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7253	Adj. General	6190	2000	870	9060	36	1314	–	1350	4	68
7264	Rec. Ctr.	9690	–	870	10,560	432	268	–	700	8	37
7270	HQ & Classroom	4990	–	870	5860	357	430	–	787	3	63
7285	Theater	9490	–	870	10,360	1225	428	–	1653	7	70
7305	Spec. Weap. Clrm.	4990	–	2340	7330	114	418	–	532	3	40
7350	Motor Rep. Shop	13,490	–	2340	15,830	32	1646	–	1678	9	53

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7404	Barracks	5790	–	870	6660	1464	–	–	1464	4	84
7424	Barracks	5790	–	870	6660	1464	–	–	1464	4	84
7450	HQ	6140	–	870	7010	279	418	–	697	4	51
7485	Bowling Ctr.	3840	–	870	4710	706	167	–	873	2	77
7500	Motor Rep. Shop	13,490	–	2340	15,830	32	1646	–	1678	9	53
7520	Motor Rep. Shop	13,490	–	2340	15,830	32	1334	–	1366	9	46
7602	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7604	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7606	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7608	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7610	Barracks	5490	–	870	6360	158	–	–	158	3	16
7612	Barracks	5490	–	870	6360	158	–	–	158	3	16
7614	Barracks	5490	–	870	6360	158	–	–	158	3	16
7616	Barracks	5490	–	870	6360	158	–	–	158	3	16
7618	Barracks	5490	–	870	6360	158	–	–	158	3	16
7620	HQ & Classroom	3100	–	870	3970	357	430	–	787	3	79
7622	Admin.	6390	–	870	7260	849	888	–	1737	4	88
7624	Admin. & Classroom	3100	–	870	3970	386	430	–	816	3	81
7626	Dispensary	3100	–	870	3970	106	151	–	257	3	37
7630	Admin. & Classroom	4990	–	870	5860	386	430	–	816	3	64
7632	Gym	2200	–	870	3070	211	1381	–	1592	2	122
7636	HQ	6140	–	870	7010	279	418	–	697	4	51
7638	Admin. & Classroom	4990	–	870	5860	386	430	–	816	3	64
7640	Branch Px	2350	–	870	3220	106	152	–	258	2	43
7642	Barracks	5490	–	870	6360	158	–	–	158	3	16

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7644	Barracks	5490	–	870	6360	158	–	–	158	3	16
7646	Barracks	5490	–	870	6360	158	–	–	158	3	16
7648	Barracks	5490	–	870	6360	158	–	–	158	3	16
7650	Barracks	5490	–	870	6360	158	–	–	158	3	16
7652	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7654	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7656	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7658	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7665	Dental Clinic	3840	–	870	4710	864	880	–	1744	2	108
7670	Dental Clinic	4650	–	870	5520	2481	–	1072	3553	4	130
7720	Motor Rep. Shop	13,490	–	2340	15,830	32	1646	–	1678	9	53
7739	Redeye	4840	–	100	4940	119	171	–	290	3	34
7740	Motor Rep. Shop	13,490	–	2340	15,830	32	1646	–	1678	9	53
7760	Motor Rep. Shop	13,490	–	2340	15,830	32	1334	–	1366	9	46
7780	Motor Rep. Shop	13,490	–	2340	15,830	32	1334	–	1366	9	46
7802	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7804	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7806	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7808	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7810	Barracks	5490	–	870	6360	158	–	–	158	3	16
7812	Barracks	5490	–	870	6360	158	–	–	158	3	16
7814	Barracks	5490	–	870	6360	158	–	–	158	3	16
7816	Barracks	5490	–	870	6360	158	–	–	158	3	16
7818	Barracks	5490	–	870	6360	158	–	–	158	3	16
7820	HQ & Classroom	3100	–	870	3970	357	430	–	787	3	79

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
7824	HQ	6390	–	870	7260	800	888	–	1688	4	87
7826	Dispensary	3100	–	870	3970	113	162	–	275	3	39
7832	Gym	2200	–	870	3070	211	1381	–	1592	2	122
7834	HQ	4990	–	870	5860	111	418	–	529	3	48
7836	HQ	6390	–	870	7260	800	888	–	1688	4	87
7840	Branch Px	2350	–	870	3220	106	152	–	258	2	43
7842	Barracks	5490	–	870	6360	158	–	–	158	3	16
7844	Barracks	5490	–	870	6360	158	–	–	158	3	16
7846	Barracks	5490	–	870	6360	158	–	–	158	3	16
7848	Barracks	5490	–	870	6360	158	–	–	158	3	16
7850	Barracks	5490	–	870	6360	158	–	–	158	3	16
7852	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7854	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7856	Mess Hall	7290	–	870	8160	225	142	–	367	5	27
7858	Five Co. Admin. & Stor.	8240	–	870	9110	138	470	–	608	6	38
7866	Theater	8940	–	870	9810	692	242	–	934	7	49
7900	Motor Repair Shop	13,490	–	2340	15,830	32	1334	–	1366	9	46
7920	Motor Repair Shop	66,370	–	2340	68,710	2293	9719	–	12,012	40	74
7940	Motor Repair Shop	13,490	–	2340	15,830	32	1334	–	1366	9	46
7960	Motor Repair Shop	13,490	–	2340	15,830	32	1646	–	1678	9	53
8002	Type B Barracks	6290	–	870	7160	199	–	–	199	4	18
8006	Type B Barracks	6290	–	870	7160	199	–	–	199	4	18
8008	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8010	Day Room	2350	–	870	3220	91	–	52	143	2	27
8012	Type B Barracks	6290	–	870	7160	199	–	–	199	4	18

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
8014	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8018	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8020	Day Room	4240	–	870	5110	91	–	52	143	2	18
8021	Five Co Admin & Supply	9640	–	870	10,510	272	–	470	742	7	39
8023	Five Co Admin & Supply	9640	–	870	10,510	272	–	470	742	7	39
8025	HQ & Classroom	6390	–	870	7260	585	–	894	1479	4	81
8037	HQ & Classroom	6390	–	870	7260	585	–	894	1479	4	81
8038	Type B Barracks	6290	–	870	7160	199	–	–	199	4	18
8040	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8042	Type B Barracks	6290	–	870	7160	199	–	–	199	4	18
8046	Day Room	2350	–	870	3220	91	–	52	143	2	27
8048	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8050	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8052	Type B Barracks	6290	–	870	7160	199	–	–	199	4	18
8054	Type A Barracks	2200	–	870	3070	100	–	–	100	2	21
8056	Day Room	4240	–	870	5110	91	–	52	143	2	18
8057	Five Co Admin & Supply	9640	–	870	10,510	272	–	470	742	7	39
8059	Five Co Admin & Supply	9640	–	870	10,510	272	–	470	742	7	39
8063	Mess Hall	5790	–	870	6660	1257	–	1035	2292	4	104
8065	Dispensary	1950	–	870	2820	106	–	151	257	2	48
8067	Branch Px	1950	–	870	2820	106	–	152	258	2	48
8069	Gym	10,890	–	870	11,760	564	–	1327	1891	9	70
8071	HQ	3840	–	870	4710	517	–	382	899	2	78
8073	Central Plant	91,370	–	870	92,240	350	–	7686	8036	74	46
8300	Motor Repair Shop	13,490	–	2340	15,830	32	–	1646	1678	9	53

Table B-6

ENERGY POINTS
COST/BENEFIT SUMMARY

BLDG. NO.	BLDG. FUNCTION	COSTS (FEB. 82)				ENERGY SAVED MEGA BTU/YR				NO. PTS	E/C RATIO
		PTS	EXIST CONTROLS	DTM	TOTAL	ELECTRIC	GAS	OIL	TOTAL		
8320	Motor Repair Shop	13,490	–	2340	15,830	32	–	1646	1678	9	53
8340	Motor Repair Shop	13,490	–	2340	15,830	32	–	1646	1678	9	53
8360	Motor Repair Shop	62,130	–	2340	64,470	49	–	2502	2551	42	24

Table B-6

ENERGY POINTS COST/BENEFIT SUMMARY TOTALS

Building Count

Number of buildings having energy points	178
Number of buildings without energy points	16
Total buildings examined	194

Energy Point Count

Buildings	924
OA points at FID's	14
Anzio Substation	1
Total	939

Costs (Feb. 82 dollars)

Pts.	Exist. Controls	DTM	Total
$1,378,940	$20,600	$209,020	$1,608,560

Total costs for field hardware, modifications to existing controls, and DTM $1,608,560

Energy Savings (Mega BTU/Yr)

Electricity	Gas	Oil	Total
53,861	68,958	24,717	147,536

Total energy saved – 145,600 Mega BTU/Yr

APPENDIX C – REFERENCES

REFERENCES

1. U.S. Army Corps of Engineers, Huntsville Division, Preliminary Survey & Feasibility Study for Energy Monitoring and Control Systems, HNDSP80-013-EDME, 1980.

2. Energy Monitoring and Control Systems, Technical Manual TM5-815-2, U.S. Army Corps of Engineers, Huntsville Division, September 1, 1981.

3. Office of the Chief of Engineers, Army Facilities Energy Plan, October 1, 1980.

4. Ottaviano, Victor B., Frank M. Neal, and Joseph S. Cataudella, Energy Management, Ottaviano Technical Services, Inc., 150 Broad Hollow Road, Mellville NY 11746.

5. Honeywell, Energy Conservation with Comfort, 2nd ed., U.S.A., Sept. 1979.

6. The Electrification Council, Energy Management Action Course, 2nd ed., 1981.

7. Burns & McDonnell, Integrated Energy Master Plan for Fort Riley, KS, 1980.

8. Burns & McDonnell, Integrated Energy Master Plan for Fort Carson, CO, 1980.

9. Johnson Controls, Ft. Riley Energy Study, 1978.

10. Johnson Controls, Energy Conservation Control, 1978

11. Large Energy Monitoring and Control Systems, CEGS-13947, U.S. Army Corps of Engineers, Huntsville Division, Huntsville, Alabama, June 1, 1981.

12. Medium Energy Monitoring and Control Systems, CEGS-13948, U.S. Army Corps of Engineers, Huntsville Division, Huntsville, Alabama, June 1, 1981.

13. Small Energy Monitoring and Control Systems, GCES-13949, U.S. Army Corps of Engineers, Huntsville Division, Huntsville, Alabama, June 1, 1981.

14. Micro Energy Monitoring and Control Systems, CEGS-13950, U.S. Army Corps of Engineers, Huntsville Division, Huntsville, Alabama, June 1, 1981.

15. American Society of Heating, Refreigerating and Air Conditioning Engineers (ASHRAE), 1976 Systems Volume.

16. ASHRAE, 1977 Fundamentals Volume.

17. ASHRAE, 1978 Applications Volume.

18. ASHRAE, 1979 Equipment Volume.

19. ASHRAE, 1980 Systems Volume.

20. ASHRAE, 1981 Fundamentals Volume.

21. Departments of the Air Force, the Army and the Navy, TM5-785, Engineering Weather Data, 1978.

22. Robert M. Graves and Paul R. Hirsch (Argonne National Laboratory), CALERDA Users Manual, 1979.

23. Consultants Computation Bureau, CCB/CALERDA User Introduction Manual for the CDC Cybernet System, 1979.

24. Communique from TRADOC General Staff, Energy Monitoring and Control System (EMCS) - Lessons Learned, 1 October 1981.

25. Communique from TRADOC General Staff, Staffing Guidance for Energy Monitoring and Control Systems (EMCS), 28 May 1980.

26. U.S. Army Forces Command, Facilities Energy Plan Summary, March 1981.

27. Ft. Eustis DFE, Energy Monitoring and Control System, Video Tape EMCS-4A-777-8103-B, June 1981.

28. Alfred Berutti, Marine Base Saves Millions by Managing Energy, Electrical Construction and Maintenance, June 1981.

29. Dept. of the Army, Office of the Chief of Engineers, ETL-1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded through the MCA Program, 8 February 1980.

30. Paula Ruth, MSU Snubs Powers Opts for Oak/Adec, Energy User News, December 7, 1981.

31. Honeywell's Winning Bid Links EMS Bills, Savings, Energy User News, December 7, 1981.

32. Preventive Maintenance System Helps Prevent HVAC Failures at NYC's School for Firemen, Air Conditioning, Heating & Refregeration News, December 14, 1981.

33. Headquarters, Dept. of the Army, AR415-17, Construction Cost Estimating for Military Programming, 15 February 1980.

34. National Bureau of Standards, NBSIR 81-2346, Energy Management and Control Systems (EMCS) User Satisfaction Study, August 1981.

APPENDIX D – ABBREVIATIONS AND GLOSSARY

ABBREVIATIONS

AA	Analog alarm
AC	Alternating current
AHU	Air handling unit
ATC	Automatic temperature control
B/C	Benefit to cost ratio
Btu	British thermal unit
CCC	Central communications controller
CCU	Central control unit
CHW	Chilled water
CDW	Condenser Water
CPA	Control point adjustment
CPU	Central processing unit
CRT	Cathode ray tube
CT	Current transformer
CWE	Current working estimate
dB	Decibel
dc	Direct current
DE	Data environment
DPS	Differential pressure switch
DTM	Data transmission media

DX	Direct expansion
E/C	Energy to cost ratio
EMCS	Energy monitoring and control systems
FCB	Failover control board
FID	Field interface device
FS	Flow switch
h,hr	hour
HOA	Hand-off-automatic
HVAC	Heating, ventilating, and air conditioning
HW	Hot water
I/O	Input/output
kHz	Kilohertz
kW	Kilowatt
kWh	Kilowatt-hour
MBtu	1,000 Btu
MBtuh	1,000 Btu per hour
MCR	Master control room
Mega Btu	1,000,000 (one million) Btu
Mega Btuh	1,000,000 (one million) Btu per hour
MHz	Megahertz
MUX	Multiplexer
OA	Outdoor air
O&M	Operations and maintenance

PS	Pressure switch
psi	Pounds per square inch
psia	Pounds per square inch, absolute
psid	Pounds per square inch, differential
psig	Pounds per square inch, gauge
RA	Return air
RH	Relative humidity
RTC	Real time clock
SIOH	Supervision, inspection and overhead
S/S	Start/stop
UPS	Uninterruptible power supply

GLOSSARY

Architecture:	The general organization and structure of hardware and software.
Automatic Temperature Control (ATC)	A local loop network of pneumatic or electric/electronic devices which are interconnected to control temperature.
Central Memory:	Core or semiconductor memory which communicates directly with a CPU.
Central Communication Controller (CCC):	A computer that performs data gathering and dissemination from and to the FIDs, as well as providing limited backup to the CCU.
Central Control Unit (CCU):	A process control digital computer that includes a CPU, central memory, and I/O bus.

Central Processing Unit (CPU):	The portion of a computer that performs the interpretation and execution of instructions. It does not include memory or I/O.
Clock:	A device or a part of a device that generates all the timing pulses for the coordination of a digital system. System clocks usually generate two or more clock phases. Each phase is a separate, square wave pulse train output.
Compiler:	A language translator which converts source statements written in a high level language into multiple machine instructions. A compiler translates the entire program before it is executed.
Control Point Adjustment (CPA):	The procedure of changing the operating point of a local loop controller from a remote location.

Control Sequence: Equipment operating order established upon a correlated set of data environment conditions.

Data Environment (DE): The sensors and control devices connected to a single FID from the equipment and systems sampled or controlled.

Data Transmission Media (DTM): Transmission equipment including cables and interface modules (excluding MODEMs) permitting transmission of digital and analog information.

Deck: In HVAC terminology, the air discharge of the hot or cold coil in a duct serving a conditioned space.

Demand: The term used to describe the maximum rate of use of electrical energy averaged over a specific interval of time and usually expressed in kilowatts.

Disk Storage: A bulk storage, random access device for storing digital information. Usually constructed of a thin rotating circular plate having a magnetizable coating, a read/write head and associated control equipment.

Distributed Processing System: A system of multiple processors each performing its own task, yet working together as a complete system under the supervision of a central computer, to perform multiple associated tasks.

Failover Control Board: A bus switch to transfer the communications function from CCU to CCC in the event of CCU failure, or the communications function from CCC to CCU in the event of CCC failure.

Fall-Back Mode: The pre-selected operating mode of a FID when communcations cease with the MCR or the operating sequence of each local

control loop when the FID to which it is connected ceases to function.

Input/Output (I/O) Device: Digital hardware that transmits or receives data.

Interactive: Functions performed by an operator with the machine prompting or otherwise assisting these endeavors, while continuing to perform all other tasks as scheduled.

Local Loop Control: The controls for any system or subsystem which existed prior to the installation of an EMCS and which will continue to function when the EMCS is nonoperative.

Memory: Any device that can store logic 1 and logic 0 bits in such a manner that a single bit or group of bits can be assessed and retrieved.

Microcomputer:	A computer system based on a microprocessor and containing all the memory and interface hardware necessary to perform calculations and specified transformations.
Microprocessor:	A central processing unit fabricated as one integrated circuit.
Point:	Individual connected monitor or control devices. Example: relay, temperature sensor.
Predictor/Corrector Program:	Applications software which allows continuous prediction of a future value and subsequent correction based on actual measurements.
Program:	A sequence of instructions causing the computer to perform a specified function.
Real Time:	A situation in which a computer monitors, evaluates, reaches decisions, and effects

controls within the response time of the fastest phenomenon.

Software: A term used to describe all programs whether in machine, assembly, or high-level language.

Zone: An area composed of a building, a portion of a building, or a group of buildings affected by a single device or piece of equipment.

APPENDIX E – METHOD OF ANALYSIS AND EXAMPLES

APPENDIX E

METHOD OF ANALYSIS AND EXAMPLES

A. PURPOSE

The purpose of this Appendix is to illustrate the procedure used in arriving at the conclusions and recommendations of this report. Examples are included.

B. REFERENCES

The procedure to be used in the analysis is specified in two publications:

1. Preliminary Survey & Feasibility Study for Energy Monitoring and Control Systems, HNDSP80-013-EDME, issued circa 1980.

2. Energy Monitoring & Control Systems, TM5-815-2, Chapter 7, issued September 1, 1981.

C. FIVE VOLUMES OF THE REPORT

This report is separated into five volumes, for ease of publication.

Volume 1 is the Executive Summary. As the name implies, Volume 1 summarizes the information developed in Volumes 2 through 4.

Volume 2 is the Report Analysis. Volume 2 contains such information as energy savings calculations, some preliminary cost estimates, and notes on the components of the EMCS. Volume 2 also contains the correspondence on this report.

Volumes 3, 4 and 5 contain building-by-building report forms required by the Corps of Engineers.

Volume 3 has five basic types of forms:

1. The Check Sheet, which lists potential EMCS programs.

2. The Energy Point Summary, which lists costs, energy savings and the number of energy points.

3. The Building E/C Ratio Calculation.

4. The Building Summary, which is the same as the Energy Points Summary, except all EMCS points (energy points plus maintenance points) are included.

5. The I/O Summary Table, which describes in detail the EMCS points to be installed.

Volumes 4 and 5 contain information gathered during the field survey. Such information as occupancy schedules and equipment characteristics are noted.

D. PROCEDURE

1. Prepare a list of candidate buildings. Good candidates are those buildings likely to benefit most from the EMCS. A preliminary list was prepared by the Facility Engineer. The final list was the result of discussions between the Facility Engineer and Burns & McDonnell.

2. The field survey was conducted. A total of 194 buildings were visited. The results of this survey comprise Volumes 4 and 5. Some groups of buildings were found to be identical for our purposes. Some buildings were found to be similar in all respects except size. (Example: Some storage buildings are built to accommodate four companies, some for five companies. Essentially, the smaller buildings are equal to 4/5 of the larger.) These similarities reduced the amount of repetitive analysis.

   Volumes 4 and 5 contain the results of the field survey.

3. Computer programs were prepared. Because of the similarities found in the field survey, only about 50 computer models were necessary. Actually, the computer models had been created under an earlier contract by Burns & McDonnell. These models were modified where necessary and rerun. The result was a set of models and corresponding energy data which formed the foundation of the study.

   The computer programs are not included in this report, but they are referenced in the analyses of Volume 2.

Steps 4 through 7 were done for energy points in each building. (See Appendix B for an explanation of the energy points.)

4. Based on the field survey and computer programs, check sheets were prepared. The check sheets indicated those EMCS programs likely to save energy. The check sheets also indicated those EMCS programs which cannot save energy.

   At this point, some buildings were eliminated from further consideration, since no EMCS programs could save energy for them.

   The check sheets are in Volume 3.

5. Energy savings were estimated. Those EMCS programs judged earlier to have a high potential were pursued. Wherever possible, the computer program was the basis for the estimated energy saved. In some cases, other methods of calculating energy savings were used. The total energy savings for each building was determined.

   Energy savings are calculated in Volume 2.

Where costs and savings were close, costs to implement the energy savings were estimated and compared to the present value of the energy saved.

This was done in Volume 2.

6. All energy conservation methods having costs higher than savings were eliminated. Some energy conservation methods which were marginal were eliminated on the basis of O&M (operation and maintenance) costs. The check sheets prepared in Step 4 were revised accordingly. Following this step some more buildings were eliminated from futher consideration.

   This step was done in the analysis of Volume 2. The revised check sheets are in Volume 3.

7. Total savings and costs were calculated for each building. Then E/C ratios were calculated for each building. Number of points were estimated for each building.

   These figures are in Volume 3.

8. Cost savings due to electrical demand limiting and costs to implement were estimated.

   Information on demand limiting can be found in the appropriate sections of Volumes 2 and 3.

9. Number of points were totalled.

10. Characteristics and costs of central computer equipment were estimated.

    See Volume 2 for this information.

11. Costs of central computer equipment were prorated (on the basis of $ fixed cost per Mega Btu saved) and added to "per-building" costs.

    This was done on the Building E/C Ratio calculation sheets in Volume 3.

12. E/C ratios were calculated for each building (see Volume 3). Buildings were ranked by E/C ratio (See Table II-3 in Volume 1 for results).

13. Costs such as maintenance and training were calculated (See Volume 2, Part 7).

14. Life cycle cost analysis was done for the total project. Results are shown in Table SC-3.

15. Maintenance points were identified.

16. Steps 4 through 7 were repeated for maintenance plus energy points in each building.

17. Steps 9 through 11 and 13 through 14 were repeated for energy points plus maintenance points.

E. EXAMPLE 1 - DISPENSARY 7034

1. Dispensary 7034 was one of the original candidate buildings selected by the Facilities Engineer.

2. The survey of this building can be found in Volume 4. This is a single-story office-type building, 3842 total gross square feet, occupied hours 0700 to 1500, Monday through Friday.

3. The computer models (in this case, there was more than one model) for Building 7034 are described on page 8-9 of Volume 2.

   Following this, steps 4 through 7 were performed for energy points.

4. A check sheet was prepared to separate EMCS programs having energy saving potential from the programs having no potential. The check sheet for Building 7034 can be found in Volume 3. At this time, some programs were marked with a (1), meaning those programs cannot be applied to Building 7034 and, therefore, cannot save energy. Hence, the programs marked with a (1) were eliminated from further consideration.

   At this point, nine EMCS programs remained to be analyzed (scheduled start/stop, optimum start/stop, day/night setback, dry-bulb economizer, enthalpy economizer, ventilation and

recirculation, hot deck/cold deck temperature reset, hot water outside air reset, and lighting controls).

5. Energy savings were estimated. See pages 8-9 through 8-22 of Volume 2. By this analysis, scheduled start/stop and day/night setback were found to be beneficial. Optimum start/stop was found to be beneficial, too, since optimum start/stop is worthwhile wherever scheduled start/stop is justified (the cost difference between the two is insignificant for our purposes).

   Dry-bulb economizer and hot deck/cold deck temperature reset were eliminated from further consideration, because Building 7034 already had those features.

6. Enthalpy economizer was eliminated because (according to the computer simulation) there was no significant reduction in energy use. Ventilation and recirculation was eliminated because the start/stop functions (scheduled start/stop and optimum start/stop) essentially have this feature - the outdoor air dampers of the air handler close automatically when the unit is off. Hot water outside air reset requires piping modifications which cost more than the expected savings, so it was eliminated.

In summary, only scheduled start/stop, optimum start/stop and day/night setback were worthwhile programs. The check sheet in Volume 3 was changed.

7. Total savings, costs, E/C ratio and number of energy points was determined. This information is found in Volume 3.

8. Following this, steps 4 through 7 were repeated for maintenance points plus energy points. For Building 7034, there are two energy points (a space thermostat and a start/stop switch for the air handler) and three maintenance points (a start/stop with status indicator for the boiler and two temperatures sensors - for cold deck and hot deck - for the air handlers).

F. EXAMPLE 2 - HQ 355

1. HQ 355 was one of the original candidate buildings selected by the Facilities Engineer.

2. The survey of this building can be found in Volume 4. This is a two-story building, of 3,230 square feet gross floor area. It is occupied from 0730 to 0430, Monday through Friday.

3. No computer model was prepared for this building. The construction of the building and its occupancy are similar to Dispensary 7034. Therefore, a reasonable estimate can be made by prorating the Dispensary 7034 savings on the basis of gross square foot floor area.

   Following this, steps 4 through 7 were performed for the energy points.

4. A check sheet was prepared to separate EMCS programs having energy savings potential from the programs having no potential. This check sheet can be found in Volume 3.

   At this time, nine programs were eliminated (these are marked with a (1) on the check sheet). The remaining programs were: scheduled start/stop, optimum start/stop, duty cycling, demand limiting, day/night setback, hot water outside air reset, lighting control, and outdoor air start/stop.

5. Worthwhile EMCS programs were selected and energy savings were estimated. See page 8-67 of Volume 2. Night setback savings

was estimated at 139 MegaBtu/yr, by prorating the savings of Dispensary 7034.

Scheduled start/stop, optimum start/stop, duty cycling, demand limiting and outdoor air start/stop were determined to be worthwhile, but no energy savings were calculated. These programs will be applied to a 1/4-hp pump. They cost nothing to install because the start/stop switch and thermostat had already been charged against night setback. But we felt that the savings would be insignificant.

Hot water outside air reset is not worthwhile; costs exceed benefits (see page 8-3 of Volume 2). Lighting control was eliminated because we knew by experience that this could not be justified for a small building like 355.

6. The check sheet was revised accordingly.

7. Total savings, costs, E/C ratio and number of energy points was determined. This information is in Volume 3.

8. Following this, steps 4 through 7 were repeated for maintenance points plus energy points. A start/stop with status indicator was added for the boiler.

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